



## IFC 100 Handbook

Signal converter for electromagnetic flowmeters

Electronic revision:  
ER 3.1.x

The documentation is only complete when used in combination with the relevant documentation for the flow sensor.

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## 1.1 Software history

The "Electronic Revision" (ER) is consulted to document the revision status of electronic equipment according to NE 53 for all GDC devices. It is easy to see from the ER whether troubleshooting or larger changes in the electronic equipment have taken place and how that has affected the compatibility.

### Changes and effect on compatibility

1	Downwards compatible changes and fault repair with no effect on operation (e.g. spelling mistakes on display)	
2- _	Downwards compatible hardware and/or software change of interfaces:	
	H	HART®
	P	PROFIBUS
	F	Foundation Fieldbus
	M	Modbus
X	all interfaces	
3- _	Downwards compatible hardware and/or software change of inputs and outputs:	
	I	Current output
	F, P	Frequency / pulse output
	S	Status output
	C	Control input
	CI	Current input
X	all inputs and outputs	
4	Downwards compatible changes with new functions	
5	Incompatible changes, i.e. electronic equipment must be changed.	



**INFORMATION!**

*In the table below, "x" is a placeholder for possible multi-digit alphanumeric combinations, depending on the available version.*

Release date	Electronic Revision	Changes and compatibility	Documentation
2007-12-11	ER 2.0.0 (SW.REV. 2.00 (2.00))	-	-
2008-02-29	ER 2.0.1 (SW.REV. 2.00 (2.00))	1	MA IFC 100 R03
2008-05-07	ER 2.0.2 (SW.REV. 2.00 (2.00))	1	MA IFC 100 R04
2008-06-27	ER 2.0.3 (SW.REV. 2.00 (2.00))	1	MA IFC 100 R04
2010-01-04	ER 2.0.4 (SW.REV. 2.00 (2.00))	1	MA IFC 100 R04
2010-01-04	ER 2.1.0 (SW.REV. 2.10 (3.00))	1; 2-H	MA IFC 100 R04
2010-07-08	ER 2.1.1 (SW.REV. 2.11 (3.00))	1	MA IFC 100 R04
2011-12-12	ER 3.0.0 (SW.REV. 3.00 (4.00))	1; 2-X; 3-X, 5-S ①	MA IFC 100 R05
2013-04-26	ER 3.0.1	1	MA IFC 100 R05

Release date	Electronic Revision	Changes and compatibility	Documentation
2014-02-14	ER 3.0.2	1	MA IFC 100 R05
2014-08-01	ER 3.1.0	1; 2-H; 2-M; 3-F; 3-P; 3-C	MA IFC 100 R05

① Incompatible change on status output: de-energised status reversed

## 1.2 Intended use

The electromagnetic flowmeters are designed exclusively to measure the flow and conductivity of electrically conductive, liquid media.



### **DANGER!**

*For devices used in hazardous areas, additional safety notes apply; please refer to the Ex documentation.*



### **WARNING!**

*If the device is not used according to the operating conditions (refer to chapter "Technical data"), the intended protection could be affected.*

## 1.3 Certifications

CE marking



The device fulfils the statutory requirements of the following EC directives:

- Low Voltage Directive 2006/95/EC
- EMC Directive 2004/108/EC

as well as

- EN 61010
- EMC specification acc. to EN 61326/A1
- NAMUR recommendations NE 21 and NE 43

The manufacturer certifies successful testing of the product by applying the CE marking.



### **DANGER!**

*For devices used in hazardous areas, additional safety notes apply; please refer to the Ex documentation.*

## 1.4 Safety instructions from the manufacturer

### 1.4.1 Copyright and data protection

The contents of this document have been created with great care. Nevertheless, we provide no guarantee that the contents are correct, complete or up-to-date.

The contents and works in this document are subject to copyright. Contributions from third parties are identified as such. Reproduction, processing, dissemination and any type of use beyond what is permitted under copyright requires written authorisation from the respective author and/or the manufacturer.

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### 1.4.2 Disclaimer

The manufacturer will not be liable for any damage of any kind by using its product, including, but not limited to direct, indirect or incidental and consequential damages.

This disclaimer does not apply in case the manufacturer has acted on purpose or with gross negligence. In the event any applicable law does not allow such limitations on implied warranties or the exclusion of limitation of certain damages, you may, if such law applies to you, not be subject to some or all of the above disclaimer, exclusions or limitations.

Any product purchased from the manufacturer is warranted in accordance with the relevant product documentation and our Terms and Conditions of Sale.

The manufacturer reserves the right to alter the content of its documents, including this disclaimer in any way, at any time, for any reason, without prior notification, and will not be liable in any way for possible consequences of such changes.



### 1.4.3 Product liability and warranty

The operator shall bear responsibility for the suitability of the device for the specific purpose. The manufacturer accepts no liability for the consequences of misuse by the operator. Improper installation and operation of the devices (systems) will cause the warranty to be void. The respective "Standard Terms and Conditions" which form the basis for the sales contract shall also apply.

### 1.4.4 Information concerning the documentation

To prevent any injury to the user or damage to the device it is essential that you read the information in this document and observe applicable national standards, safety requirements and accident prevention regulations.

If this document is not in your native language and if you have any problems understanding the text, we advise you to contact your local office for assistance. The manufacturer can not accept responsibility for any damage or injury caused by misunderstanding of the information in this document.

This document is provided to help you establish operating conditions, which will permit safe and efficient use of this device. Special considerations and precautions are also described in the document, which appear in the form of underneath icons.

### 1.4.5 Warnings and symbols used

Safety warnings are indicated by the following symbols.



**DANGER!**

*This warning refers to the immediate danger when working with electricity.*



**DANGER!**

*This warning refers to the immediate danger of burns caused by heat or hot surfaces.*



**DANGER!**

*This warning refers to the immediate danger when using this device in a hazardous atmosphere.*



**DANGER!**

*These warnings must be observed without fail. Even partial disregard of this warning can lead to serious health problems and even death. There is also the risk of seriously damaging the device or parts of the operator's plant.*



**WARNING!**

*Disregarding this safety warning, even if only in part, poses the risk of serious health problems. There is also the risk of damaging the device or parts of the operator's plant.*



**CAUTION!**

*Disregarding these instructions can result in damage to the device or to parts of the operator's plant.*



**INFORMATION!**

*These instructions contain important information for the handling of the device.*



**LEGAL NOTICE!**

*This note contains information on statutory directives and standards.*



• **HANDLING**

This symbol designates all instructions for actions to be carried out by the operator in the specified sequence.

➔ **RESULT**

This symbol refers to all important consequences of the previous actions.

## 1.5 Safety instructions for the operator



**WARNING!**

*In general, devices from the manufacturer may only be installed, commissioned, operated and maintained by properly trained and authorized personnel.  
This document is provided to help you establish operating conditions, which will permit safe and efficient use of this device.*

## 2.1 Scope of delivery

**INFORMATION!**

Inspect the packaging carefully for damages or signs of rough handling. Report damage to the carrier and to the local office of the manufacturer.

**INFORMATION!**

Do a check of the packing list to make sure that you have all the elements given in the order.

**INFORMATION!**

Look at the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.

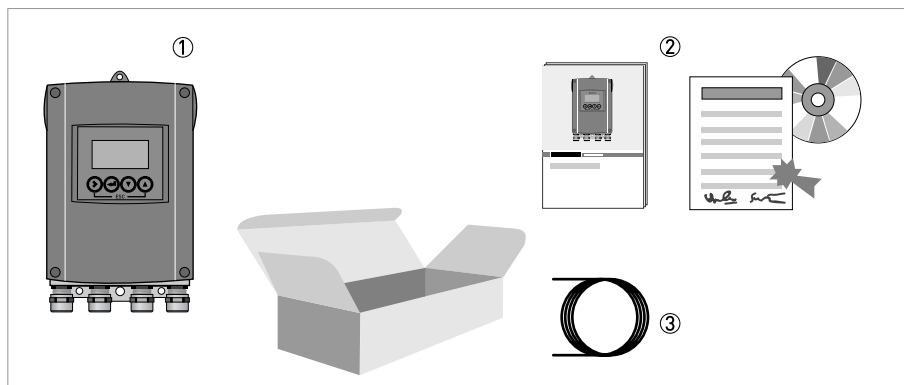


Figure 2-1: Scope of delivery

- ① Device in the version as ordered
- ② Documentation (calibration report, Quick Start, CD-ROM with product documentation for measuring sensor and signal converter)
- ③ Signal cable (only for remote version)

## 2.2 Device description

Electromagnetic flowmeters are designed exclusively to measure the flow and conductivity of electrically conductive, liquid media.

Your measuring device is supplied ready for operation. The factory settings for the operating data have been made in accordance with your order specifications.

### The following versions are available:

- Compact version (the signal converter is mounted directly on the measuring sensor)
- Remote version (electrical connection to the measuring sensor via field current and signal cable)

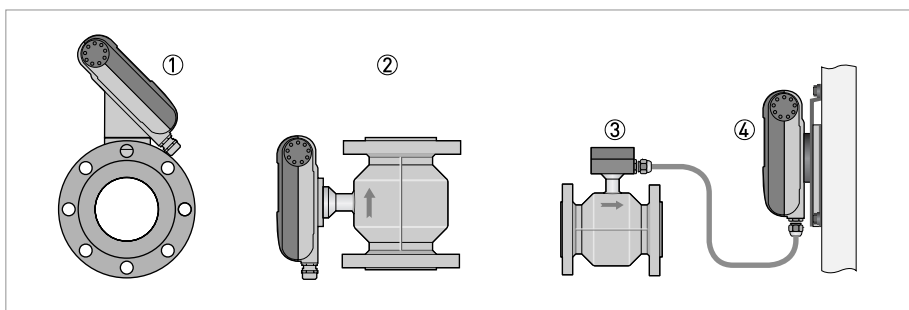


Figure 2-2: Device versions

- ① Compact version as 45° version
- ② Compact version as 0° version
- ③ Measuring sensor with connection box
- ④ Wall version

## 2.3 Nameplates



### INFORMATION!

Look at the device nameplate to ensure that the device is delivered according to your order.  
Check for the correct supply voltage printed on the nameplate.

### 2.3.1 Nameplate (example)

①			
<b>KROHNE</b>		Altometer, Dordrecht NL - 3313 LC	100-230 VAC 50-60 Hz 8 VA ②
⑦	XXXXXXXX00 S/N A07 35514 Manufact. 2007	CE	SWV 1 0 0_ (V100) ③
GKL 6 1253 f field = f line / 6			
DN 150 mm / 6 inch PED (97/23/EC)			
⑥	Wetted materials PP IP66 / 67 HC4	PS1= 0 bar@ TS1<=0 °C PS2= 0 bar@ TS2 =0 °C PS1= 24 bar@ TT= 20 °C	Type 4X/6 enclosure ④
⑤			

Figure 2-3: Example of a nameplate

- ① Manufacturer
- ② Power supply data
- ③ Software version
- ④ Tag name
- ⑤ Approvals-related pressure and temperature thresholds
- ⑥ GK/GKL values (measuring sensor constants); size (mm /inches); field frequency; protection category; materials of wetted parts
- ⑦ Product designation, serial number and manufacturing date

### 3.1 General notes on installation

**INFORMATION!**

*Inspect the packaging carefully for damages or signs of rough handling. Report damage to the carrier and to the local office of the manufacturer.*

**INFORMATION!**

*Do a check of the packing list to make sure that you have all the elements given in the order.*

**INFORMATION!**

*Look at the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.*

### 3.2 Storage

- Store the device in a dry, dust-free location.
- Avoid continuous direct sunlight.
- Store the device in its original packing.
- Storage temperature: -40...+70°C / -40...+158°F

### 3.3 Transport

**Signal converter**

- No special requirements.

**Compact version**

- Do not lift the device by the signal converter housing.
- Do not use lifting chains.
- To transport flange devices, use lifting straps. Wrap these around both process connections.

### 3.4 Installation specifications

**INFORMATION!**

*The following precautions must be taken to ensure reliable installation.*

- *Make sure that there is adequate space to the sides.*
- *Protect the signal converter from direct sunlight and install a sun shade if necessary.*
- *Signal converters installed in control cabinets require adequate cooling, e.g. by fan or heat exchanger.*
- *Do not expose the signal converter to intense vibrations. The measuring devices are tested for a vibration level in accordance with IEC 68-2-64.*

### 3.5 Mounting of the compact version



**INFORMATION!**

The signal converter is mounted directly on the measuring sensor. For installation of the flowmeter, please observe the instructions in the supplied product documentation for the measuring sensor.

### 3.6 Mounting the wall-mounted housing, remote version



**INFORMATION!**

Assembly materials and tools are not part of the delivery. Use the assembly materials and tools in compliance with the applicable occupational health and safety directives.

#### 3.6.1 Wall mounting

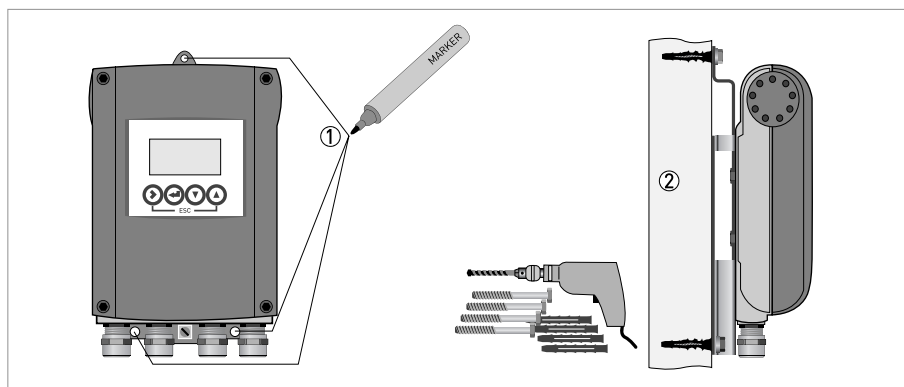
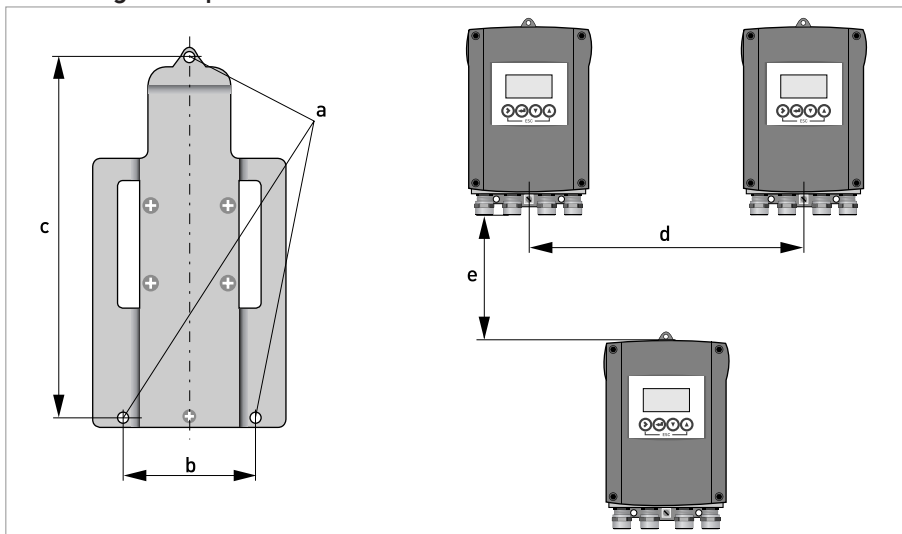


Figure 3-1: Mounting the wall-mounted housing



- ① Prepare the holes with the aid of the mounting plate. For further information refer to *Mounting plate, wall-mounted version* on page 97.
- ② Fasten the device securely to the wall with the mounting plate.

Mounting multiple devices next to each other



	[mm]	[inch]
a	Ø6.5	Ø0.26
b	87.2	3.4
c	241	9.5
d	310	12.2
e	257	10.1



## 4.1 Safety instructions

**DANGER!**

All work on the electrical connections may only be carried out with the power disconnected. Take note of the voltage data on the nameplate!

**DANGER!**

Observe the national regulations for electrical installations!

**DANGER!**

For devices used in hazardous areas, additional safety notes apply; please refer to the Ex documentation.

**WARNING!**

Observe without fail the local occupational health and safety regulations. Any work done on the electrical components of the measuring device may only be carried out by properly trained specialists.

**INFORMATION!**

Look at the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.

## 4.2 Important notes on electrical connection

**DANGER!**

Electrical connection is carried out in conformity with the VDE 0100 directive "Regulations for electrical power installations with line voltages up to 1000 V" or equivalent national regulations.

**CAUTION!**

- Use suitable cable entries for the various electrical cables.
- The measuring sensor and signal converter have been configured together at the factory. For this reason, please connect the devices in pairs. Ensure that the measuring sensor constant GK/GKL (see nameplates) are identically set.
- If delivered separately or when installing devices that were not configured together, set the signal converter to the DN size and GK/GKL of the measuring sensor, refer to Function tables on page 56.

## 4.3 Electrical cables for remote device versions, notes

### 4.3.1 Notes on signal cable A



**INFORMATION!**

*Signal cable A (type DS 300) with double shield ensures proper transmission of measured values.*

**Observe the following notes:**

- Lay the signal cable with fastening elements.
- It is permissible to lay the signal cable in water or in the ground.
- The insulating material is flame-retardant to EN 50265-2-1: 1997 and IEC 60322-1-2: 2005.
- The signal cable does not contain any halogens and is unplasticized, and remains flexible at low temperatures.
- The connection of the inner shield (10) is carried out via the stranded drain wire (1).
- The connection of the outer shield (60) is carried out via the stranded drain wire (6).

### 4.3.2 Notes on field current cable C



**DANGER!**

*A shielded 2-wire copper cable is used for the field current cable. The shielding **MUST** be connected in the housing of the measuring sensor and signal converter.*



**INFORMATION!**

*The field current cable is not part of the scope of delivery.*

### 4.3.3 Requirements for signal cables provided by the customer

**INFORMATION!**

*If the signal cable was not ordered, it is to be provided by the customer. The following requirements regarding the electrical values of the signal cable must be observed:*

**Electrical safety**

- To EN 60811 (Low Voltage Directive) or equivalent national regulations.

**Capacitance of the insulated conductors**

- Insulated conductor / insulated conductor < 50 pF/m
- Insulated conductor / shield < 150 pF/m

**Insulation resistance**

- $R_{iso} > 100 \text{ G}\Omega \times \text{km}$
- $U_{max} < 24 \text{ V}$
- $I_{max} < 100 \text{ mA}$

**Test voltages**

- Insulated conductor / inner shield 500 V
- Insulated conductor / insulated conductor 1000 V
- Insulated conductor / outer shield 1000 V

**Twisting of the insulated conductors**

- At least 10 twists per meter, important for screening magnetic fields.

## 4.4 Preparing the signal and field current cables



### INFORMATION!

Assembly materials and tools are not part of the delivery. Use the assembly materials and tools in compliance with the applicable occupational health and safety directives.

### 4.4.1 Signal cable A (type DS 300), construction

- Signal cable A is a double-shielded cable for signal transmission between the measuring sensor and signal converter.
- Bending radius:  $\geq 50 \text{ mm} / 2''$

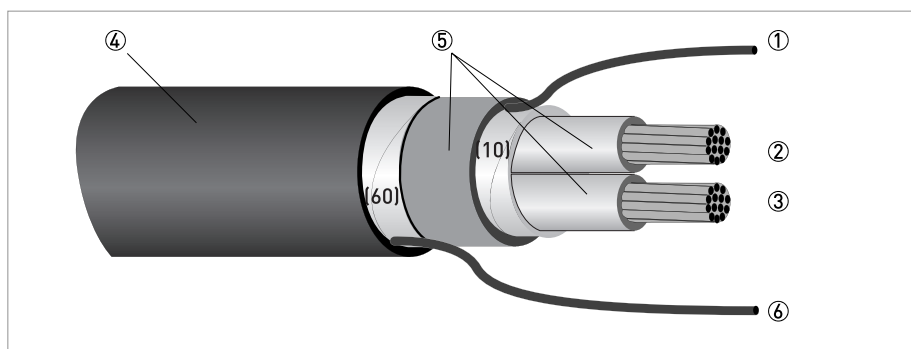


Figure 4-1: Construction of signal cable A

- ① Stranded drain wire (1) for the inner shield (10),  $1.0 \text{ mm}^2 \text{ Cu}$  / AWG 17 (not insulated, bare)
- ② Insulated wire (2),  $0.5 \text{ mm}^2 \text{ Cu}$  / AWG 20
- ③ Insulated wire (3),  $0.5 \text{ mm}^2 \text{ Cu}$  / AWG 20
- ④ Outer sheath
- ⑤ Insulation layers
- ⑥ Stranded drain wire (6) for the outer shield (60)

#### 4.4.2 Preparing signal cable A, connection to signal converter



##### INFORMATION!

Assembly materials and tools are not part of the delivery. Use the assembly materials and tools in compliance with the applicable occupational health and safety directives.

- Connection of the two shields in the signal converter is carried out via the stranded drain wires.
- Bending radius:  $\geq 50 \text{ mm} / 2''$

##### Required materials

- PVC insulating tube,  $\varnothing 2.5 \text{ mm} / 0.1''$
- Heat-shrinkable tubing
- 2 wire end ferrules to DIN 46 228: E 1.5-8 for the stranded drain wires (1, 6)
- 2 wire end ferrules to DIN 46 228: E 0.5-8 for the insulated conductors (2, 3)

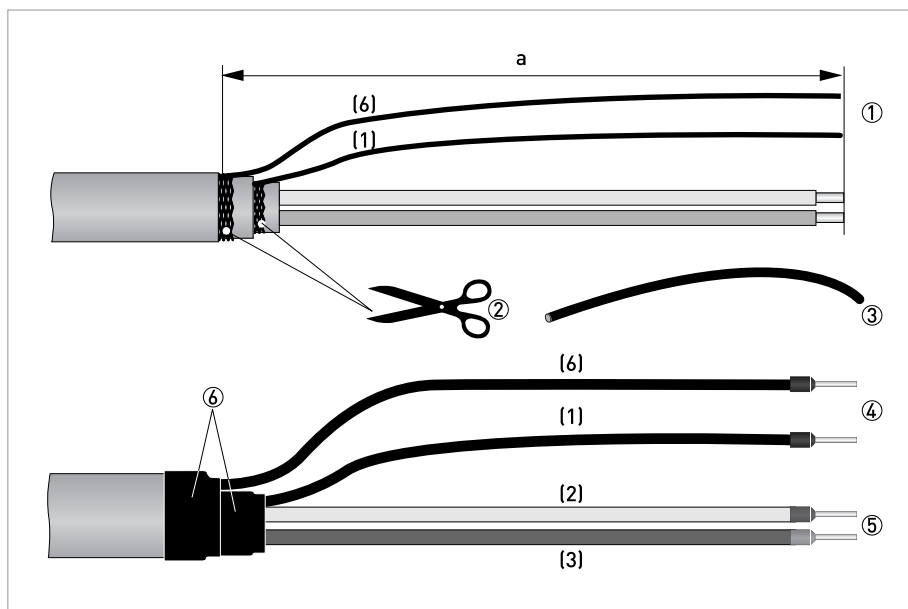


Figure 4-2: Preparation of signal cable A

$a = 80 \text{ mm} / 3.15''$



- ① Strip the conductor to dimension a.
- ② Cut off the inner shield (10) and the outer shield (60). Make sure not to damage the stranded drain wires (1, 6).
- ③ Slide the insulating tubes over the stranded drain wires (1, 6).
- ④ Crimp the wire end ferrules onto the stranded drain wire.
- ⑤ Crimp the wire end ferrules onto the conductors (2, 3).
- ⑥ Pull the heat-shrinkable tubing over the prepared signal cable.

4.4.3 Length of signal cable A



**INFORMATION!**

For temperatures of the medium above 150°C / 300°F, a special signal cable and a ZD intermediate socket are necessary. These are available including the changed electrical connection diagrams.

Measuring sensor	Nominal diameter		Min. electrical conductivity [μS/cm]	Curve for signal cable A
	DN [mm]	[inch]		
OPTIFLUX 1000 F	10...150	3/8...6	5	A1
OPTIFLUX 2000 F	25...150	1...6	20	A1
	200...1200	8...48	20	A2
OPTIFLUX 4000 F	2.5...150	1/10...6	5	A1
	200...1200	8...48	5	A2
OPTIFLUX 5000 F	2.5...100	1/10...4	5	A1
	150...250	6...10	5	A2
OPTIFLUX 6000 F	2.5...150	1/10...6	5	A1
WATERFLUX 3000 F	25...600	1...24	20	A1

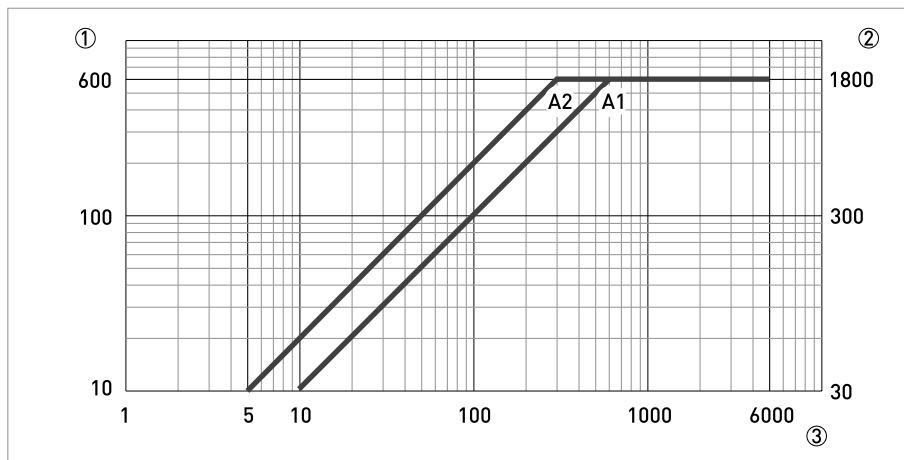


Figure 4-3: Maximum length of signal cable A

- ① Maximum length of signal cable A between the measuring sensor and signal converter [m]
- ② Maximum length of signal cable A between the measuring sensor and signal converter [ft]
- ③ Electrical conductivity of the medium being measured [μS/cm]

#### 4.4.4 Preparing field current cable C, connection to signal converter



**DANGER!**

A shielded 2-wire copper cable is used as the field current cable. The shielding **MUST** be connected in the housing of the measuring sensor and signal converter.



**INFORMATION!**

Assembly materials and tools are not part of the delivery. Use the assembly materials and tools in compliance with the applicable occupational health and safety directives.

- Field current cable C is not part of the scope of delivery.
- Bending radius:  $\geq 50 \text{ mm} / 2''$

**Required materials:**

- Shielded, at least 2-wire copper cable with suitable heat-shrinkable tubing
- Insulating tube, size according to the cable being used
- Wire end ferrules to DIN 46 228: size according to the cable being used

**Length and cross-section of field current cable C**

Length		Cross-section $A_F$ (Cu)	
[m]	[ft]	[mm <sup>2</sup> ]	[AWG]
0...150	0...492	2 x 0.75 Cu ①	2 x 18
150...300	492...984	2 x 1.5 Cu ①	2 x 14
300...600	984...1968	2 x 2.5 Cu ①	2 x 12

① Cu = copper cross-section

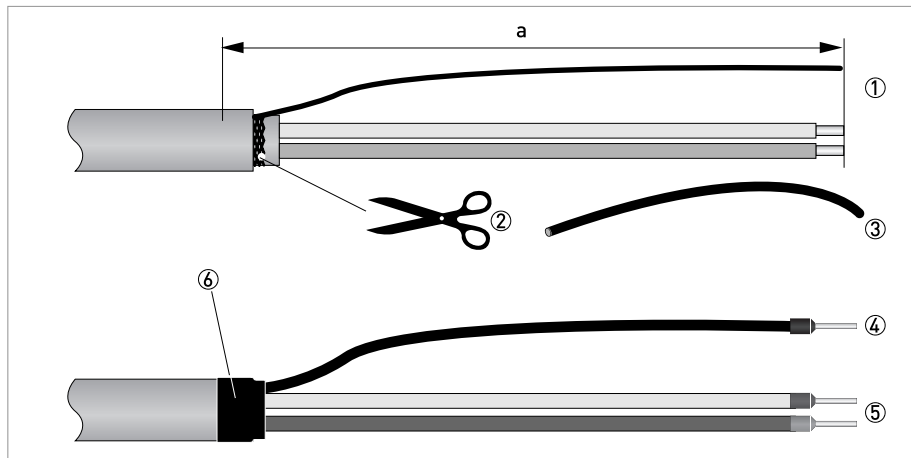


Figure 4-4: Field current cable C, preparation for the signal converter

$a = 80 \text{ mm} / 3.15''$



- ① Strip the conductor to dimension a.
- ② If a stranded drain wire is present, remove the shield that is present. Make sure not to damage the stranded drain wire.
- ③ Slide an insulating tube over the stranded drain wire.
- ④ Crimp a wire end ferrule onto the stranded drain wire.
- ⑤ Crimp the wire end ferrules on the conductors.
- ⑥ Pull a shrinkable tube over the prepared cable.



#### 4.4.5 Preparing signal cable A, connection to measuring sensor



##### INFORMATION!

Assembly materials and tools are not part of the delivery. Use the assembly materials and tools in compliance with the applicable occupational health and safety directives.

- The outer shield (60) is connected in the terminal compartment of the measuring sensor directly via the shield and a clip.
- Bending radius:  $\geq 50 \text{ mm} / 2''$

##### Required materials

- PVC insulating tube,  $\varnothing 2.0 \dots 2.5 \text{ mm} / 0.08 \dots 0.1''$
- Heat-shrinkable tubing
- Wire end ferrule to DIN 46 228: E 1.5-8 for the stranded drain wire (1)
- 2 wire end ferrules to DIN 46 228: E 0.5-8 for the insulated conductors (2, 3)

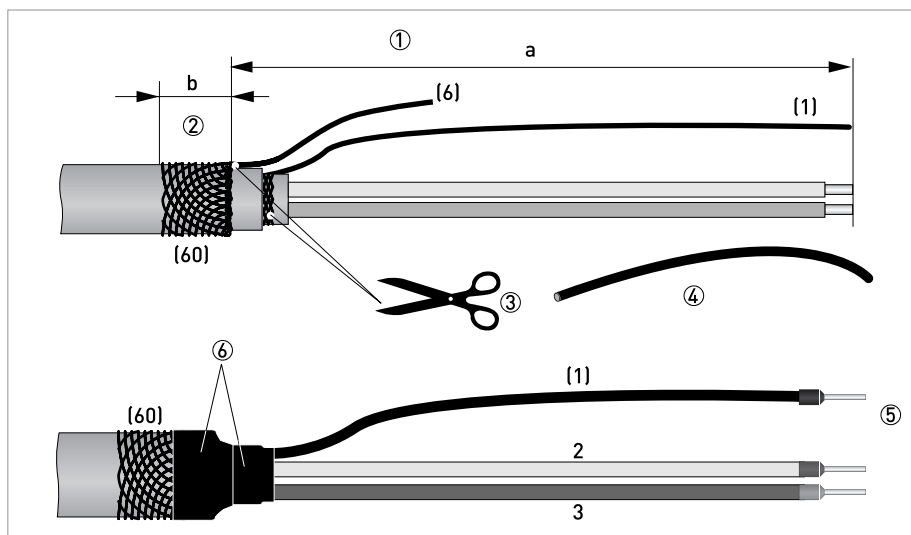


Figure 4-5: Preparing signal cable A, connection to measuring sensor

$a = 50 \text{ mm} / 2''$

$b = 10 \text{ mm} / 0.39''$



- ① Strip the conductor to dimension a.
- ② Trim the outer shield (60) to dimension b and pull it over the outer sheath.
- ③ Remove the stranded drain wire (6) of the outer shield and the inner shield. Make sure not to damage the stranded drain wire (1) of the inner shield.
- ④ Slide an insulating tube over the stranded drain wire (1).
- ⑤ Crimp the wire end ferrules onto conductors 2 and 3 and the stranded drain wire (1).
- ⑥ Pull the heat-shrinkable tubing over the prepared signal cable.

## 4.4.6 Preparing field current cable C, connection to measuring sensor

**INFORMATION!**

Assembly materials and tools are not part of the delivery. Use the assembly materials and tools in compliance with the applicable occupational health and safety directives.

- The field current cable is not included in delivery.
- The shield is connected in the terminal compartment of the measuring sensor directly via the shield and a clip.
- Bending radius:  $\geq 50 \text{ mm} / 2''$

**Required materials**

- Shielded 2-wire insulated copper cable
- Insulating tube, size according to the cable being used
- Heat-shrinkable tubing
- Wire end ferrules to DIN 46 228: size according to the cable being used

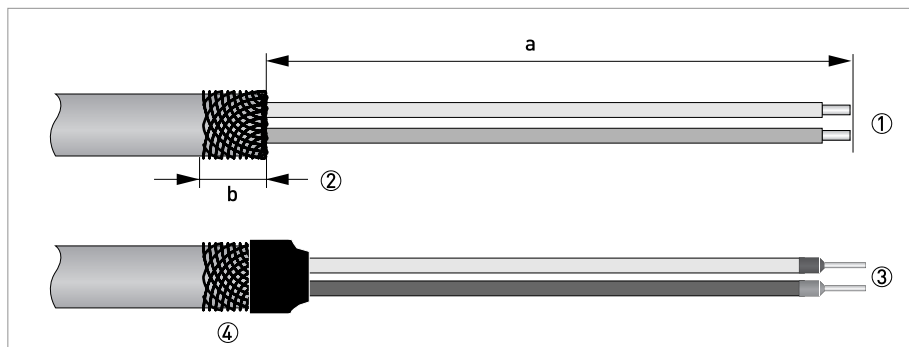


Figure 4-6: Preparation of field current cable C

$a = 50 \text{ mm} / 2''$

$b = 10 \text{ mm} / 0.4''$



- ① Strip the conductor to dimension a.
- ② Trim the outer shield to dimension b and pull it over the outer sheath.
- ③ Crimp wire end ferrules onto both conductors.
- ④ Pull a shrinkable tube over the prepared cable.

## 4.5 Connecting the signal and field current cables



***DANGER!***

*Cables may only be connected when the power is switched off.*



***DANGER!***

*The device must be grounded in accordance with regulations in order to protect personnel against electric shocks.*



***DANGER!***

*For devices used in hazardous areas, additional safety notes apply; please refer to the Ex documentation.*



***WARNING!***

*Observe without fail the local occupational health and safety regulations. Any work done on the electrical components of the measuring device may only be carried out by properly trained specialists.*

### 4.5.1 Connecting the signal and field current cables to the signal converter, remote version

**INFORMATION!**

The compact version is supplied preassembled from the factory.

#### Open housing

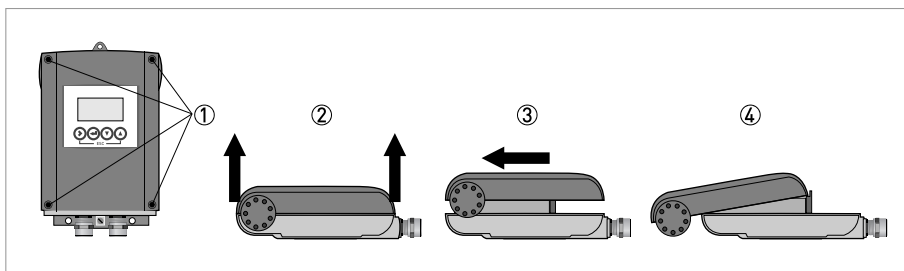


Figure 4-7: Open housing



- ① Loosen the 4 screws with a suitable tool.
- ② Lift the housing at the top and bottom at the same time.
- ③ Slide the housing cover upward.
- ④ The housing cover is guided and held by the inside hinge.

### Connecting the signal and field current cables

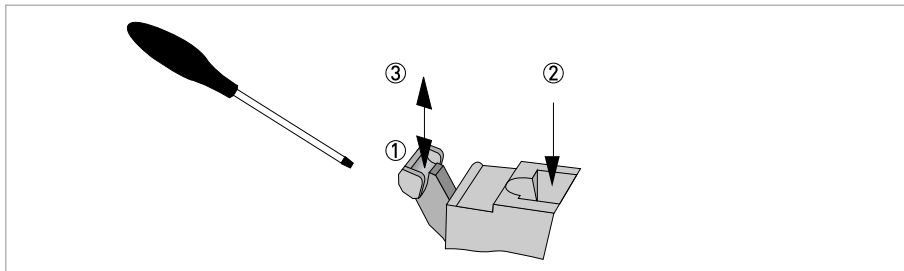


Figure 4-8: Function of the electrical connection terminal



#### Connect the electrical conductors as follows:

- ① Push the lever downwards with a screwdriver in good condition (blade: 3.5 mm wide and 0.5 mm thick).
- ② Insert the electrical conductor into the plug.
- ③ The conductor will be clamped as soon as the lever is released.

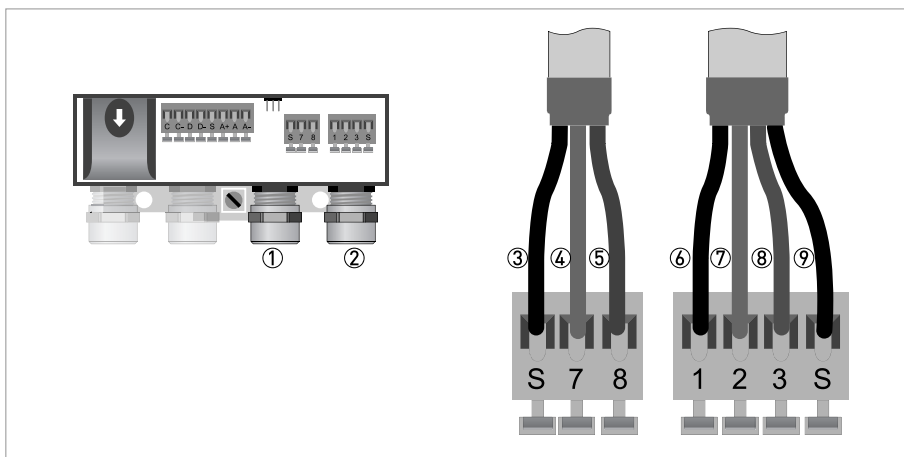


Figure 4-9: Connecting the signal and field current cables

- ① Cable entry for field current cable
- ② Cable entry for signal cable
- ③ Connecting the field current cable shield
- ④ Electrical conductor (7)
- ⑤ Electrical conductor (8)
- ⑥ Stranded drain wire (1) of the inner shield (10) of the signal cable
- ⑦ Electrical conductor (2)
- ⑧ Electrical conductor (3)
- ⑨ Stranded drain wire (S) of the outer shield (60)

## 4.5.2 Connection diagram for signal and field current cable

**DANGER!**

The device must be grounded in accordance with regulations in order to protect personnel against electric shocks.

- A shielded 2-wire copper cable is used as the field current cable. The shielding **MUST** be connected in the housing of the measuring sensor and signal converter.
- The outer shield (60) is connected in the terminal compartment of the measuring sensor directly via the shield and a clip.
- Bending radius of signal and field current cable:  $\geq 50 \text{ mm} / 2''$
- The following illustration is schematic. The positions of the electrical connection terminals may vary depending on the housing version.

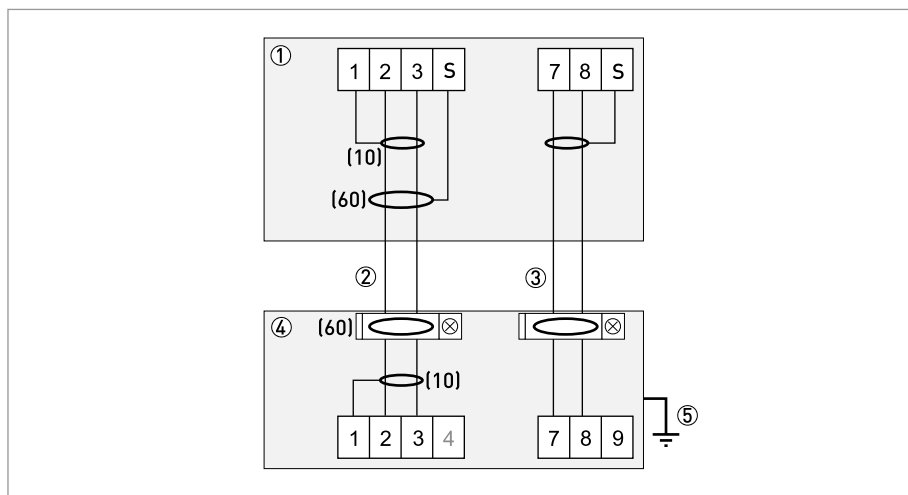


Figure 4-10: Connection diagram for signal and field current cable

- ① Electrical terminal compartment in signal converter
- ② Signal cable A
- ③ Field current cable C
- ④ Electrical terminal compartment in measuring sensor
- ⑤ Functional ground FE

## 4.6 Grounding the measuring sensor

### 4.6.1 Classical method



**CAUTION!**

*There should be no difference in potential between the measuring sensor and the housing or protective earth of the signal converter!*

- The measuring sensor must be properly grounded.
- The grounding cable should not transmit any interference voltages.
- Do not use the grounding cable to connect any other electrical devices to ground at the same time.
- The measuring sensors are connected to ground by means of a functional grounding conductor FE.
- Special grounding instructions for the various measuring sensors are provided in the separate documentation for the measuring sensor.
- The documentation for the measuring sensor also contain descriptions on how to use grounding rings and how to install the measuring sensor in metal or plastic pipes or in pipes which are coated on the inside.

## 4.7 Connecting the power supply



### **DANGER!**

The device must be grounded in accordance with regulations in order to protect personnel against electric shocks.

- The housings of the devices, which are designed to protect the electronic equipment from dust and moisture, should be kept well closed at all times. Creepage distances and clearances are dimensioned to VDE 0110 and IEC 664 for pollution severity 2. Supply circuits are designed for overvoltage category III and the output circuits for overvoltage category II.
- Fuse protection ( $I_N \leq 16 \text{ A}$ ) for the infeed power circuit, and also a separator (switch, circuit breaker) to isolate the signal converter must be provided.

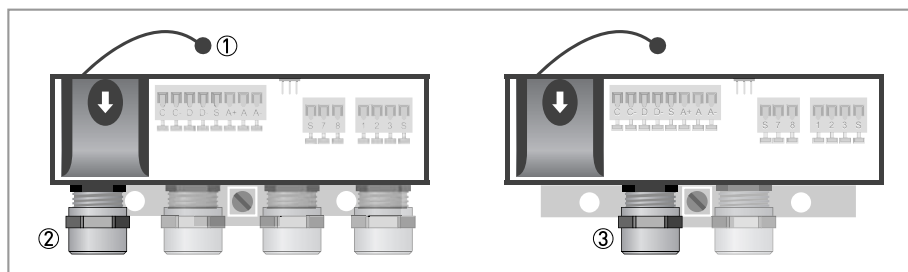


Figure 4-11: Terminal compartment for power supply

- ① Retaining band of the cover
- ② Cable entry for power supply, remote version
- ③ Cable entry for power supply, compact version

### Version overview

Version	Non-Ex	Ex
100...230 VAC	Standard	Optional
24 VDC	Standard	-
24 VAC/DC	Standard	Optional





- Open the cover of the electrical terminal compartment by pressing down and pulling forwards at the same time.

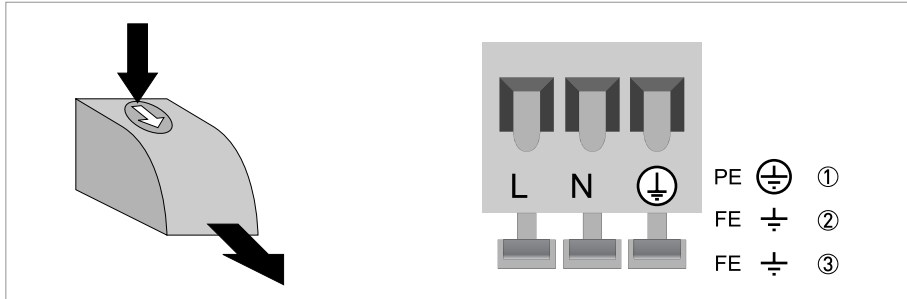


Figure 4-12: Power supply connection

- ① 100...230 VAC (-15% / +10%), 8 VA
- ② 24 VDC (-55% / +30%), 4 W
- ③ 24 VAC/DC (AC: -15% / +10%; DC: -25% / +30%), 7 VA or 4 W



- Close the cover after the power has been connected.

### 100...230 VAC (tolerance range: -15% / +10%)

- Note the power supply voltage and frequency (50...60 Hz) on the nameplate.



#### **INFORMATION!**

240 VAC + 5% is included in the tolerance range.

### 24 VDC (tolerance range: -55% / +30%)

- Note the data on the nameplate!
- When connecting to functional extra-low voltages, provide a facility for protective separation (PELV) (acc. to VDE 0100 / VDE 0106 and/or IEC 364 / IEC 536 or relevant national regulations).



#### **INFORMATION!**

12 VDC - 10% is included in the tolerance range.

### 24 VAC/DC (tolerance range: AC: -15% / +10%; DC: -25% / +30%)

- AC: Note the power supply voltage and frequency (50...60 Hz) on the nameplate.
- AC/DC: When connecting to functional extra-low voltages, provide a facility for protective separation (PELV) (acc. to VDE 0100 / VDE 0106 and/or IEC 364 / IEC 536 or relevant national regulations).



#### **INFORMATION!**

12 V is **not** included in the tolerance range.

## 4.8 Inputs and outputs, overview

### 4.8.1 Description of the CG number

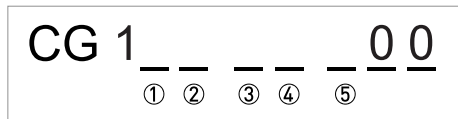


Figure 4-13: Marking [CG number] of the electronics module and output variants

- ① ID number: 0
- ② ID number: 0 = standard; 9 = special
- ③ Power supply
- ④ Display (language versions)
- ⑤ Output version

### 4.8.2 Fixed, non-alterable output versions

This signal converter is available with various output combinations.

- The grey boxes in the tables denote unassigned or unused connection terminals.
- In the table, only the final digits of the CG no. are depicted.
- Connection terminal A+ is only operable in the basic output version.

#### Basic outputs (I/O) (Standard)

CG no.	Connection terminals							
	C	C-	D	D-	S	A+	A	A-
1 0 0	S <sub>p</sub> / C <sub>p</sub> passive ①		P <sub>p</sub> / S <sub>p</sub> passive ①		②		I <sub>p</sub> + HART® passive ③	
							I <sub>a</sub> + HART® active ③	

① Function change by software

② Shielding

③ Function changed by reconnecting

#### Description of the used abbreviations

I <sub>a</sub>	I <sub>p</sub>	Current output active or passive
P <sub>p</sub>		Pulse/frequency output passive
S <sub>p</sub>		Status output / limit switch passive
C <sub>p</sub>		Control input passive

## Ex i, Profibus PA + DP, Foundation Fieldbus and Modbus (I/O) (Option)

CG no.	Connection terminals						
	D	D-	S	C	C-	B	B-

## Ex i (Option)

3 0 0	P <sub>p</sub> / S <sub>p</sub> passive ①	②	I <sub>p</sub> + HART <sup>®</sup> passive	
-------	---	---	--	--

## PROFIBUS PA (Option)

D 0 0	PA+ (1)	PA+ (2)	②	PA- (1)	PA- (2)	
-------	---------	---------	---	---------	---------	--

## FOUNDATION Fieldbus (Option)

E 0 0	V/D+ (1)	V/D+ (2)	②	V/D- (1)	V/D- (2)	
-------	----------	----------	---	----------	----------	--

## PROFIBUS DP (Option)

F 0 0	RxD/TxD+ / P / +B (1)	RxD/TxD- / N / -A (1)	②	Termination N / -T	Termination P / +T	RxD/TxD+ / P / +B (2)	RxD/TxD- / N / -A (2)
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## Modbus (Option)

G 0 0	P <sub>p</sub> / S <sub>p</sub> passive	②	+3.3 V; 560 Ω	Common	Sign. A (D0-)	Sign. B (D1+)
-------	---	---	---------------	--------	---------------	---------------

① Function change by software

② Shielding

**INFORMATION!**

Supplementary instructions related to the communication busses Foundation Fieldbus, Profibus PA/DP and Modbus are available on the website (Download Center).

## 4.9 Description of the inputs and outputs

### 4.9.1 Current output

- All outputs are electrically isolated from each other and from all other circuits.
- All operating data and functions can be adjusted.
- Passive mode:  
External power  $U_{\text{ext}} \leq 32 \text{ VDC}$  at  $I \leq 22 \text{ mA}$
- Active mode:  
Load impedance  $R_L \leq 750 \Omega$  at  $I \leq 22 \text{ mA}$
- Self-monitoring: interruption or load impedance too high in the current output loop
- Error message possible via status output, error indication on LC display.
- Current value error detection can be adjusted.
- Automatic range conversion via threshold. The setting range for the threshold is between 5 and 80% of  $Q_{100\%}$ ,  $\pm 0...5\%$  hysteresis (corresponding ratio from smaller to larger range of 1:20 to 1:1.25).  
Signaling of the active range possible via a status output (adjustable).
- Forward/reverse flow measurement (F/R mode) is possible.

**INFORMATION!**

For further information refer to *Connection diagrams of outputs on page 41* and refer to *Technical data on page 85*.

**DANGER!**

For devices used in hazardous areas, additional safety notes apply; please refer to the *Ex documentation*.

#### 4.9.2 Pulse output and frequency output

- All outputs are electrically isolated from each other and from all other circuits.
- All operating data and functions can be adjusted.
- Passive mode:  
External power supply required:  $U_{\text{ext}} \leq 32 \text{ VDC}$

**For the basic I/O signal converter:**

$I \leq 20 \text{ mA}$  at  $f \leq 10 \text{ kHz}$  (over range up to  $f_{\text{max}} \leq 12 \text{ kHz}$ )

$I \leq 100 \text{ mA}$  at  $f \leq 100 \text{ Hz}$

**For the Ex i I/O signal converter:**

NAMUR characteristic  $4.7 \text{ mA} / 0.77 \text{ mA}$  at  $f \leq 10 \text{ kHz}$  (over range up to  $f_{\text{max}} \leq 12 \text{ kHz}$ )

**For the Modbus I/O signal converter:**

$I \leq 100 \text{ mA}$  at  $f \leq 1 \text{ kHz}$  (over range up to  $f_{\text{max}} \leq 1.2 \text{ kHz}$ )

- Scaling:  
Frequency output: in pulses per time unit (e.g. 1000 pulses/s at  $Q_{100\%}$ );  
Pulse output: quantity per pulse.
- Pulse width:  
symmetric (pulse duty factor 1:1, independent of output frequency)  
automatic (with fixed pulse width, duty factor approx. 1:1 at  $Q_{100\%}$ )  
fixed (pulse width adjustable as required from 0.05 ms...2 s)
- Forward/reverse flow measurement (F/R mode) is possible.
- The pulse output and frequency output can also be used as a status output / limit switch.



**INFORMATION!**

For further information refer to *Connection diagrams of outputs on page 41* and refer to *Technical data on page 85*.



**DANGER!**

For devices used in hazardous areas, additional safety notes apply; please refer to the *Ex documentation*.

### 4.9.3 Status output and limit switch

- The status outputs / limit switches are electrically isolated from each other and from all other circuits.
- The output stages of the status outputs / limit switches behave like relay contacts.
- All operating data and functions can be adjusted.
- Passive mode:  
External power supply required:  $U_{\text{ext}} \leq 32 \text{ VDC}$ ;  $I \leq 100 \text{ mA}$

**For the Ex i I/O signal converter:**

NAMUR characteristic 4.7 mA / 0.77 mA

- For information on the adjustable operating states refer to *Function tables* on page 56.



**INFORMATION!**

For further information refer to *Connection diagrams of outputs* on page 41 and refer to *Technical data* on page 85.



**DANGER!**

For devices used in hazardous areas, additional safety notes apply; please refer to the *Ex documentation*.

#### 4.9.4 Control input

**INFORMATION!**

*Which I/O version and inputs/outputs are installed in your signal converter are indicated on the sticker in the cover of the terminal compartment.*

- All control inputs are electrically isolated from each other and from all other circuits.
- All operating data and functions can be adjusted.
- Passive mode:  
External power supply required:  $U_{\text{ext}} \leq 32 \text{ VDC}$
- For information on the adjustable operating states refer to *Function tables* on page 56.

**INFORMATION!**

*For further information refer to Connection diagrams of outputs on page 41 and refer to Technical data on page 85.*

## 4.10 Electrical connection of the outputs



### INFORMATION!

Assembly materials and tools are not part of the delivery. Use the assembly materials and tools in compliance with the applicable occupational health and safety directives.

### 4.10.1 Electrical connection of the outputs



### DANGER!

All work on the electrical connections may only be carried out with the power disconnected. Take note of the voltage data on the nameplate!

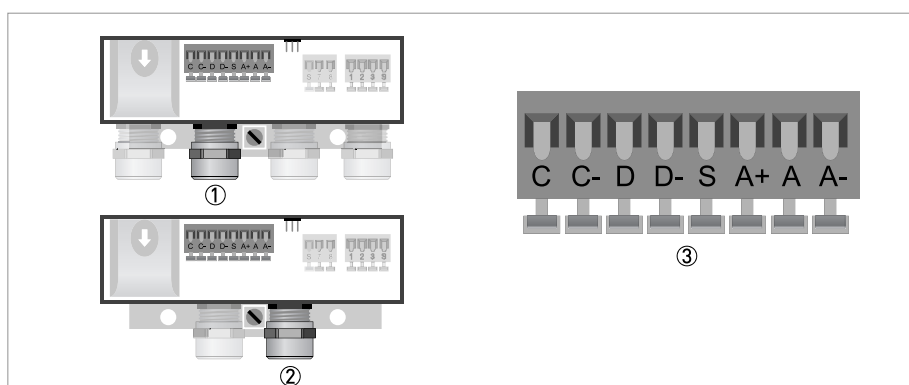


Figure 4-14: Connection of outputs

- ① Cable entry, remote version
- ② Cable entry, compact version
- ③ Terminal S for shield



- Open the housing cover
- Push the prepared cables through the cable entries and connect the necessary conductors.
- Connect the shield.
- Close the housing cover.



### INFORMATION!

Ensure that the housing gasket is properly fitted, clean and undamaged.



### 4.10.2 Laying electrical cables correctly

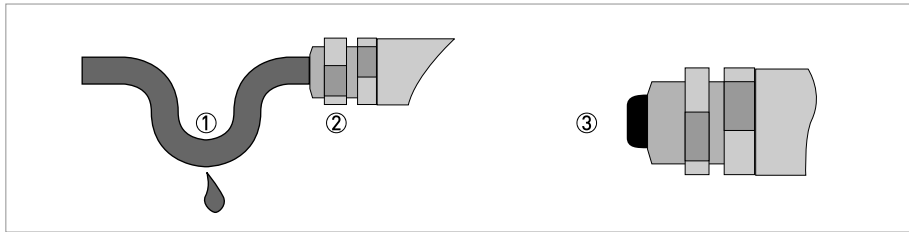


Figure 4-15: Protect housing from dust and water



- ① For compact versions with nearly horizontally-oriented cable entries, lay the necessary electric cables with a drip loop as shown in the illustration.
- ② Tighten the screw connection of the cable entry securely.
- ③ Seal cable entries that are not needed with a plug.

## 4.11 Connection diagrams of outputs

### 4.11.1 Important notes

- All groups are electrically isolated from each other and from all other output circuits.
- Passive mode: An external power supply is necessary to operate (activation) the subsequent devices ( $U_{ext}$ ).
- Active mode: The signal converter supplies the power for operation (activation) of the subsequent devices, observe max. operating data.
- Terminals that are not used should not have any conductive connection to other electrically conductive parts.



**DANGER!**

*For devices used in hazardous areas, additional safety notes apply; please refer to the Ex documentation.*

#### Description of the used abbreviations

$I_a$	$I_p$	Current output active or passive
$P_p$		Pulse/frequency output passive
$S_p$		Status output / limit switch passive
$C_p$		Control input passive

4.11.2 Description of the electrical symbols


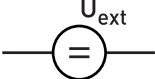



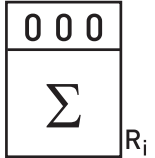

	<p>mA meter 0...20 mA or 4...20 mA and other <math>R_L</math> is the internal resistance of the measuring point including the cable resistance</p>
	<p>DC voltage source (<math>U_{ext}</math>), external power supply, any connection polarity</p>
	<p>DC voltage source (<math>U_{ext}</math>), observe connection polarity according to connection diagrams</p>
	<p>Internal DC voltage source</p>
	<p>Controlled internal power source in the device</p>
	<p>Electronic or electromagnetic counter At frequencies above 100 Hz, shielded cables must be used to connect the counters. <math>R_i</math> Internal resistance of the counter</p>
	<p>Button, NO contact or similar</p>

Table 4-1: Description of symbols

### 4.11.3 Basic outputs



**CAUTION!**  
Observe connection polarity.

#### Current output active (HART<sup>®</sup>)

- $U_{\text{int, nom}} = 20 \text{ VDC}$
- $I \leq 22 \text{ mA}$
- $R_L \leq 750 \Omega$
- HART<sup>®</sup> at connection terminals A

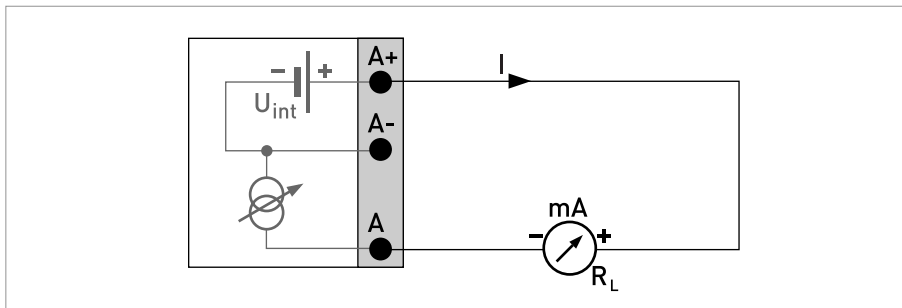


Figure 4-16: Current output active  $I_a$

#### Current output passive (HART<sup>®</sup>)

- $U_{\text{int, nom}} = 20 \text{ VDC}$
- $U_{\text{ext}} \leq 32 \text{ VDC}$
- $I \leq 22 \text{ mA}$
- $U_0 \geq 2 \text{ V}$  at  $I = 22 \text{ mA}$
- $R_L \leq (U_{\text{ext}} - U_0) / I_{\text{max}}$
- HART<sup>®</sup> at connection terminals A

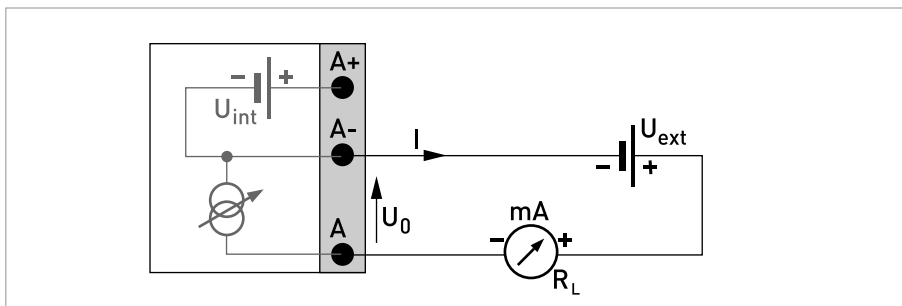


Figure 4-17: Current output passive  $I_p$

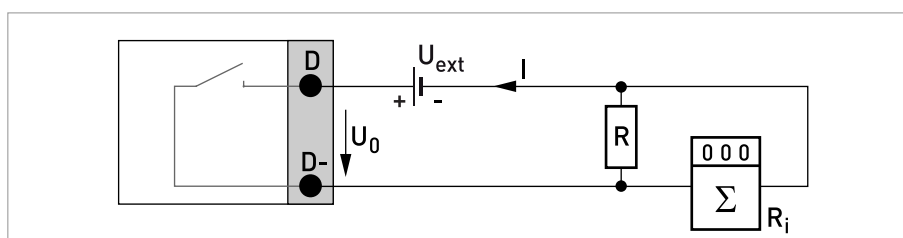
**INFORMATION!**

- Shielding takes place at the electrical connection (S) of the output terminal block.
- Any connection polarity.

**Pulse/frequency output passive (standard)**

- $U_{\text{ext}} \leq 32 \text{ VDC}$
- $f_{\text{max}}$  in the operating menu set to  $f_{\text{max}} \leq 100 \text{ Hz}$ :  
 $I \leq 100 \text{ mA}$   
 $R_L \leq 47 \text{ k}\Omega$   
 closed:  
 $U_0 \leq 0.2 \text{ V}$  at  $I = 10 \text{ mA}$   
 $U_0 \leq 2 \text{ V}$  at  $I = 100 \text{ mA}$   
 open:  
 $I \leq 0.05 \text{ mA}$  at  $U_{\text{ext}} = 32 \text{ V}$
- $f_{\text{max}}$  in operating menu set to  $100 \text{ Hz} < f_{\text{max}} \leq 10 \text{ kHz}$ :  
 (over range up to  $f_{\text{max}} \leq 12 \text{ kHz}$ )  
 $I \leq 20 \text{ mA}$   
 $R_L \leq 10 \text{ k}\Omega$  for  $f \leq 1 \text{ kHz}$   
 $R_L \leq 1 \text{ k}\Omega$  for  $f \leq 10 \text{ kHz}$   
 closed:  
 $U_0 \leq 1.5 \text{ V}$  at  $I = 1 \text{ mA}$   
 $U_0 \leq 2.5 \text{ V}$  at  $I = 10 \text{ mA}$   
 $U_0 \leq 5 \text{ V}$  at  $I = 20 \text{ mA}$   
 open:  
 $I \leq 0.05 \text{ mA}$  at  $U_{\text{ext}} = 32 \text{ V}$
- The minimum load impedance  $R_{L, \text{min}}$  is calculated as follows:  

$$R_{L, \text{min}} = (U_{\text{ext}} - U_0) / I_{\text{max}}$$
- Can also be set as status output; for the electrical connection refer to status output connection diagram.
- The output is open if the device is de-energised.

Figure 4-18: Pulse/frequency output passive  $P_p$

### Pulse/frequency output passive (Modbus)

- $U_{\text{ext}} \leq 32 \text{ VDC}$
- $f_{\text{max}}$  in the operating menu set to  $f_{\text{max}} \leq 1 \text{ kHz}$ :  
 $I \leq 100 \text{ mA}$   
 $R_L \leq 47 \text{ k}\Omega$   
 closed:  
 $U_{0, \text{max}} = 0.2 \text{ V}$  at  $I \leq 10 \text{ mA}$   
 $U_{0, \text{max}} = 2 \text{ V}$  at  $I \leq 100 \text{ mA}$   
 open:  
 $I \leq 0.05 \text{ mA}$  at  $U_{\text{ext}} = 32 \text{ VDC}$
- The minimum load impedance  $R_{L, \text{min}}$  is calculated as follows:  
 $R_{L, \text{min}} = (U_{\text{ext}} - U_0) / I_{\text{max}}$
- Can also be set as status output; for the electrical connection refer to status output connection diagram.
- The output is open if the device is de-energised.



#### **INFORMATION!**

*Any connection polarity.*

### Status output / limit switch passive

- $U_{\text{ext}} \leq 32 \text{ VDC}$
- $I \leq 100 \text{ mA}$
- $R_L = 47 \text{ k}\Omega$   
 closed:  
 $U_0 \leq 0.2 \text{ V}$  at  $I = 10 \text{ mA}$   
 $U_0 \leq 2 \text{ V}$  at  $I = 100 \text{ mA}$   
 open:  
 $I \leq 0.05 \text{ mA}$  at  $U_{\text{ext}} = 32 \text{ V}$
- The output is open if the device is de-energised.

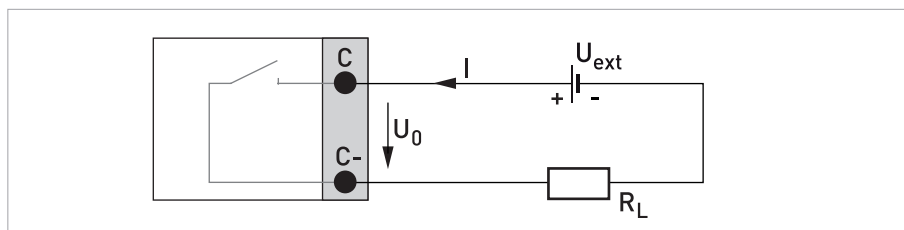


Figure 4-19: Status output / limit switch passive  $S_p$

**INFORMATION!**

- Any connection polarity.

**Control input passive**

- $U_{\text{ext}} \leq 32 \text{ VDC}$
- $I_{\text{nom}} = 6.5 \text{ mA}$  at  $U_{\text{ext}} = 24 \text{ VDC}$   
 $I_{\text{nom}} = 8.2 \text{ mA}$  at  $U_{\text{ext}} = 32 \text{ VDC}$
- Switching point for identifying "contact open or closed":  
 Contact open (off):  $U_0 \leq 2.5 \text{ V}$  with  $I_{\text{nom}} = 0.4 \text{ mA}$   
 Contact closed (on):  $U_0 \geq 8 \text{ V}$  with  $I_{\text{nom}} = 2.8 \text{ mA}$
- Can also be set as a status output; for the electrical connection refer to status output connection diagram.

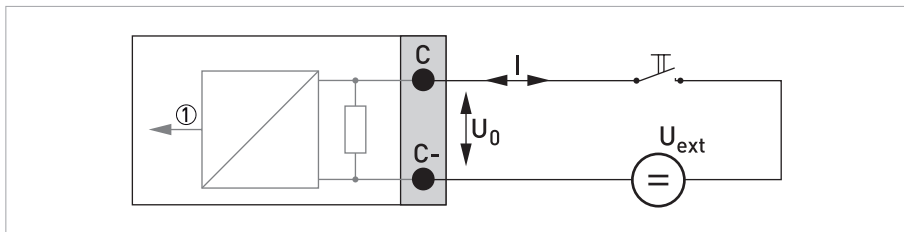


Figure 4-20: Control input passive  $C_p$

① Signal

#### 4.11.4 Ex i outputs



**DANGER!**

For devices used in hazardous areas, additional safety notes apply; please refer to the Ex documentation.



**CAUTION!**

- Observe connection polarity.



**INFORMATION!**

- For further information on electrical connection refer to Description of the inputs and outputs on page 36.

#### Current output passive (HART®)

- $U_{\text{ext}} \leq 32 \text{ VDC}$
- $I \leq 22 \text{ mA}$
- $U_0 \geq 4 \text{ V}$
- $R_{L, \text{min}} = (U_{\text{ext}} - U_0) / I_{\text{max}}$
- HART® at connection terminals C

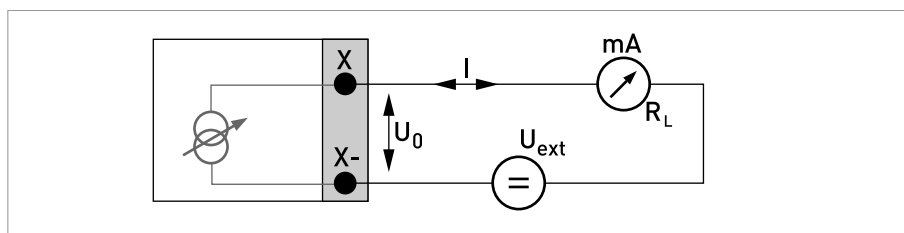


Figure 4-21: Current output passive  $I_p$  Exi

**DANGER!**

For devices used in hazardous areas, additional safety notes apply; please refer to the Ex documentation.

**CAUTION!**

- Observe connection polarity.

**Pulse/frequency output passive to NAMUR**

- Connection acc. to EN 60947-5-6
- open:  
 $I_{nom} = 0.77 \text{ mA}$
- closed:  
 $I_{nom} = 4.7 \text{ mA}$
- The output is closed when the device is de-energised.

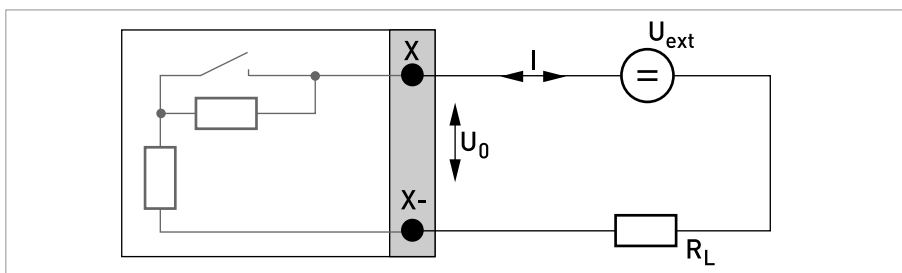


Figure 4-22: Pulse/frequency output passive  $P_N$  to NAMUR EN 60947-5-6 Ex i

**INFORMATION!**

- Any connection polarity.

**Status output / limit switch to NAMUR**

- Connection acc. to EN 60947-5-6
- open:  
 $I_{nom} = 0.77 \text{ mA}$
- closed:  
 $I_{nom} = 4.7 \text{ mA}$
- The output is closed when the device is de-energised.

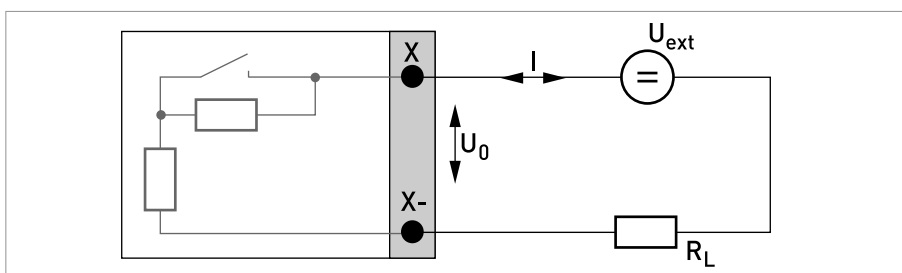


Figure 4-23: Status output / limit switch  $S_N$  to NAMUR EN 60947-5-6 Ex i



### 4.11.5 HART® connection



#### INFORMATION!

The current output always has HART® capability.

- Basic I/O: connection terminals A+/A-/A
- Ex i I/O: connection terminals C-/C

All HART® connections (point-to-point and multi-drop operation) both work actively and passively.

#### Example for active HART® connection (point-to-point)

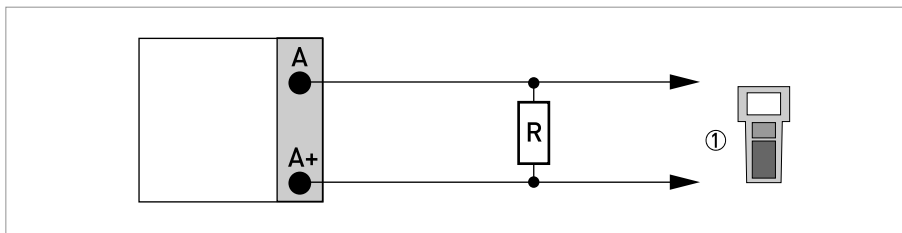


Figure 4-24: HART® connection active ( $I_a$ )

① HART® communicator

The parallel resistance to the HART® communicator must be  $R \geq 230 \Omega$ .

#### Example for passive HART® connection (multi-drop mode)

- $I: I_{0\%} \geq 4 \text{ mA}$
- Multi-drop mode  $I: I_{\text{fix}} \geq 4 \text{ mA} = I_{0\%}$
- $U_{\text{ext}} \leq 32 \text{ VDC}$
- $R \geq 230 \Omega$

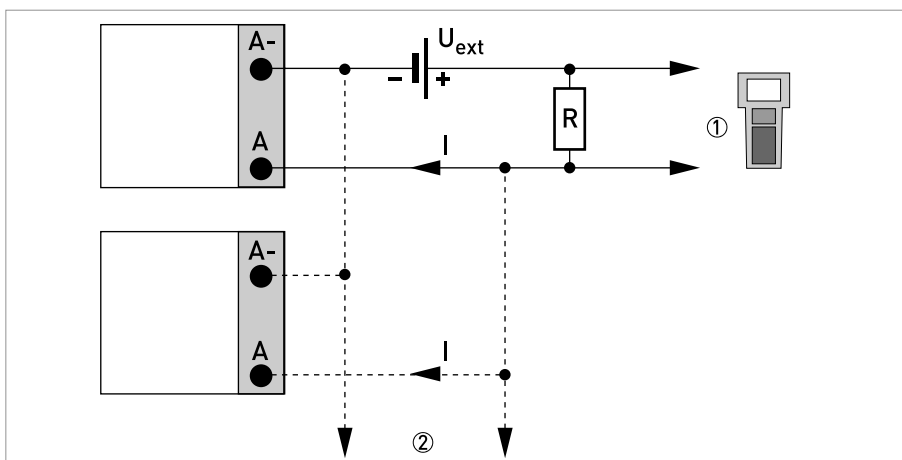


Figure 4-25: HART® connection passive ( $I_p$ )

① HART® communicator

② Other devices with HART® capability

## 5.1 Switching on the power

Before connecting to power, please check that the system has been correctly installed. This includes:

- The device must be mechanically safe and mounted in compliance with the regulations.
- The power connections must have been made in compliance with the regulations.
- The electrical terminal compartments must be secured and the covers have been screwed on.
- Check that the electrical operating data of the power supply are correct.



- Switching on the power.

## 5.2 Starting the signal converter

The measuring device, consisting of the measuring sensor and the signal converter, is supplied ready for operation. All operating data have been set at the factory in accordance with your order specifications.

When the power is switched on, a self test is carried out. After that the device immediately begins measuring, and the current values are displayed.

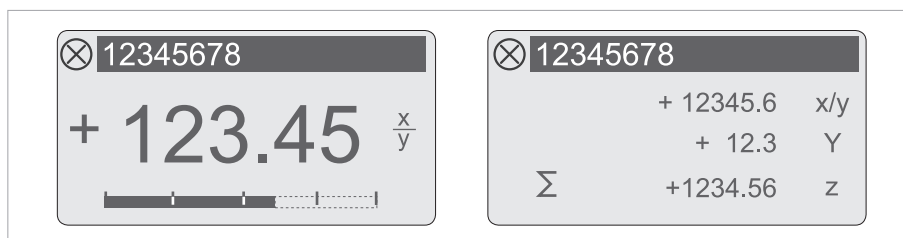


Figure 5-1: Displays in measuring mode (examples for 2 or 3 measured values)  
x, y and z denote the units of the measured values displayed

It is possible to change between the two measured value windows, the trend display and the list with the status messages by pressing the keys  $\uparrow$  and  $\downarrow$ . For information about possible status messages, their meaning and cause refer to *Status messages and diagnostic information* on page 77.

## 6.1 Display and operating elements

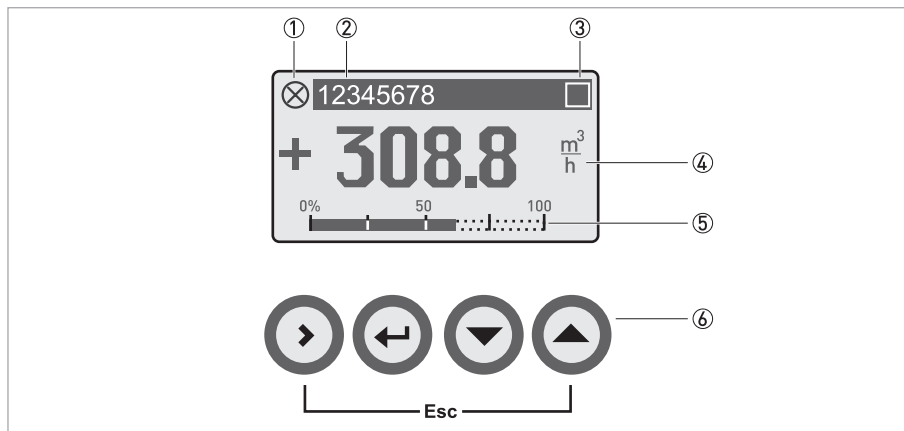


Figure 6-1: Display and operating elements (Example: flow indication with 2 measuring values)

- ① Indicates a possible status message in the status list
- ② Tag number (is only indicated if this number was entered previously by the operator)
- ③ Indicates when a key has been pressed
- ④ 1st measured variable in large representation
- ⑤ Bargraph indication
- ⑥ Keys (see table below for function and representation in text)



**INFORMATION!**

- After 5 minutes of inactivity, there is an automatic return to measuring mode. Previously changed data is not saved.

Key	Measuring mode	Menu mode	Submenu or function mode	Parameter and data mode
>	Switch from measuring mode to menu mode; press key for 2.5 s, "quick start" menu is then displayed	Access to displayed menu, then 1st submenu is displayed	Access to displayed submenu or function	For numerical values, move cursor (highlighted in blue) one position to the right
←	Reset of display	Return to measuring mode but prompt whether the data should be saved	Press 1 to 3 times, return to menu mode, data saved	Return to submenu or function, data saved
↓ or ↑	Switch between display pages: measured value 1 + 2, trend page and status page	Select menu	Select submenu or function	Use cursor highlighted in blue to change number, unit, property and to move the decimal point
Esc (> + ↑)	-	-	Return to menu mode without acceptance of data	Return to submenu or function without acceptance of data

Table 6-1: Description of key functionality

## 6.1.1 Display in measuring mode with 2 or 3 measured values

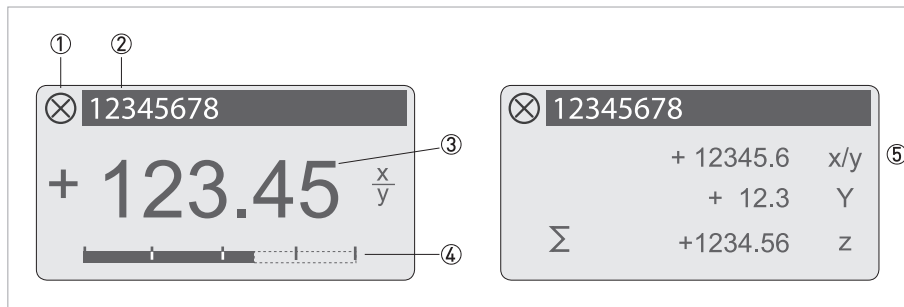


Figure 6-2: Example for display in measuring mode with 2 or 3 measured values

- ① Indicates a possible status message in the status list
- ② Tag number (is only indicated if this number was entered previously by the operator)
- ③ 1st measured variable in large depiction
- ④ Bargraph indication
- ⑤ Depiction with 3 measured values

## 6.1.2 Display for selection of sub-menu and functions, 3 lines

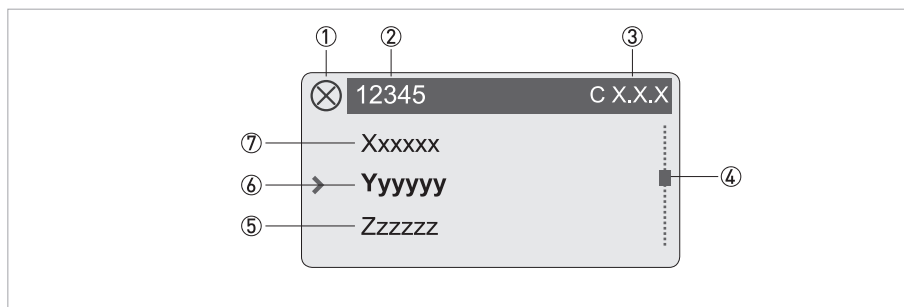


Figure 6-3: Display for selection of submenu and functions, 3 lines

- ① Indicates a possible status message in the status list
- ② Menu, submenu or function name
- ③ Number relating to ⑥
- ④ Indicates position within menu, submenu or function list
- ⑤ Next menu(s), submenu or function  
[\_\_\_ signalise in this line the end of the list]
- ⑥ Current menu(s), submenu or function
- ⑦ Previous menu(s), submenu or function  
[\_\_\_ signalise in this line the beginning of the list]

### 6.1.3 Display when setting parameters, 4 lines

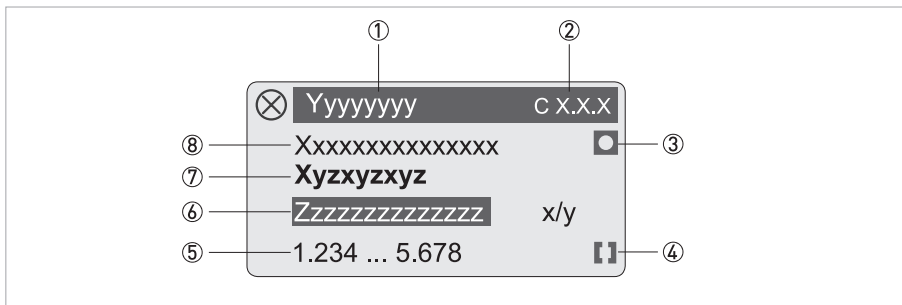


Figure 6-4: Display when setting parameters, 4 lines

- ① Current menu(s), submenu or function
- ② Number relating to ⑦
- ③ Denotes factory setting
- ④ Denotes permissible value range
- ⑤ Permissible value range for numeric values
- ⑥ Currently set value, unit or function (when selected, appears with white text, blue background)  
This is where the data is changed.
- ⑦ Current parameter
- ⑧ Factory setting of parameter

### 6.1.4 Display when previewing parameters, 4 lines

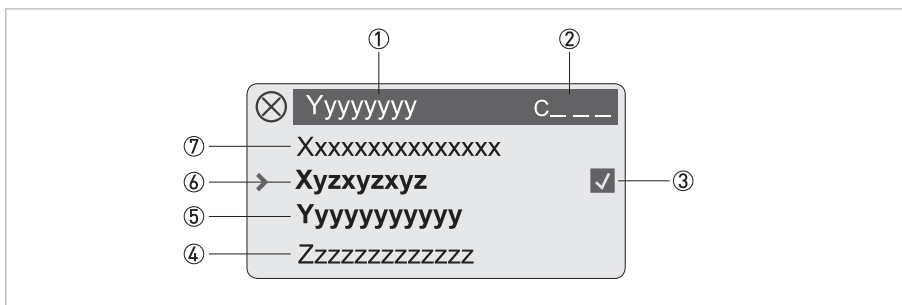


Figure 6-5: Display when previewing parameters, 4 lines

- ① Current menu(s), submenu or function
- ② Number relating to ⑥
- ③ Denotes a changed parameter (simple check of changed data when browsing through lists)
- ④ Next parameter
- ⑤ Currently set data from ⑥
- ⑥ Current parameter (for selection press key >; then see previous chapter)
- ⑦ Factory setting of parameter

## 6.2 Menu structure



**INFORMATION!**

- The menu structure for the standard device (HART®) is described. The functions for Modbus, Foundation Fieldbus and Profibus are described in detail in the corresponding supplementary instructions.
- Note the key function within and between the columns.

Measuring mode	Select menu	↓ ↑	Select menu and/or submenu	↓ ↑	Select function and set data	↓ ↑ >
←	Press > 2.5 s					
	A quick setup	> ←	A1 language	> ←	-	> ←
			A2 tag	> ←	-	
			A3 reset	> ←	A3.1 reset errors A3.2 counter 1 A3.3 counter 2	
			A4 analogue outputs	> ←	A4.1 measurement A4.2 unit A4.3 range A4.4 low flow cutoff A4.5 time constant	
			A5 digital outputs	> ←	A5.1 measurement A5.2 pulse value unit A5.3 value p. pulse A5.4 low flow cutoff	
			A7 process input	> ←	A7.1 device serial no. A7.2 zero calibration A7.3 size A7.5 GKL A7.6 coil resistance Rsp A7.7 calib. coil temp. A7.8 target conduct. A7.9 EF electr. factor A7.10 field frequency A7.11 flow direction	
←	B test	> ←	B1 simulation	> ←	Submenus on page 58	> ←
			B2 actual values			
			B3 information			
		↓↑		↓↑		↓↑>

Measuring mode		Select menu	Select menu and/or submenu	Select function and set data
		↓ ↑	↓ ↑	↓ ↑ >
←	Press > 2.5 s			
	C setup	> ←	C1 process input	> ←
			C1.1 calibration	
			C1.2 filter	
			C1.3 self test	
			C1.4 information	
			C1.5 simulation	
←		> ←	C2 I/O (Input/Output)	> ←
			C2.1 hardware	
			C2._ current output X	
			C2._ frequency out X	
			C2._ pulse output X	
			C2._ status output X	
			C2._ control input X	
			C2._ limit switch X	
←		> ←	C3 I/O counter	> ←
			C3.1 counter 1	
			C3.2 counter 2	
←		> ←	C4 I/O HART	> ←
			C4.1 PV is	
			C4.2 SV is	
			C4.3 TV is	
			C4.4 4V is	
			C4.5 HART units	
←		> ←	C5 device	> ←
			C5.1 device info	
			C5.2 display	
			C5.3 1. meas. page	
			C5.4 2. meas. page	
			C5.5 graphic page	
			C5.6 special functions	
			C5.7 units	
			C5.8 HART	
			C5.9 quick setup	
		↓ ↑		↓ ↑
			↓ ↑	↓ ↑ >

## 6.3 Function tables



### INFORMATION!

- The following tables describe the functions of the standard device with HART® connection. The functions for Modbus, Foundation Fieldbus and Profibus are described in detail in the corresponding supplementary instructions.
- Depending on the device version, not all functions are available.

### 6.3.1 Menu A, quick setup

No.	Function	Setting / Description
-----	----------	-----------------------

#### A1 language

A1	language	Language selection depends on the device version.
----	----------	---

#### A2 tag

A2	tag	Measuring point identifier (Tag no.) (also for HART® operation) appears in the LCD header (max. 8 digits).
----	-----	--

#### A3 reset?

A3	reset?	Reset error or counter.
A3.1	reset errors	reset errors? Select: no / yes
A3.2	reset counter 1	reset counter? Select: no / yes (available if activated in C5.9.1)
A3.3	reset counter 2	reset counter? Select: no / yes (available if activated in C5.9.2)

#### A4 analogue outputs (only for HART®)

A4	analogue outputs	Applicable to current output (terminal A or C), frequency output (terminal D), limit switch (terminal C and/or D) and the 1st display page / line 1
A4.1	measurement	1) Select: volume flow / mass flow / diagnosis value / flow speed / coil temperature / conductivity 2) Use for all outputs? (also use this setting for Fct. A4.2...A4.5!) Setting: no (applies only to the main current output) / yes (applies to all analogue outputs)
A4.2	unit	Selection of the unit from a list, depending on the "measurement"
A4.3	range	1) Setting for main current output (range: 0...100%) Setting: 0...x.xx (format and unit, depending on measurement, see A4.1 and A4.2 above) 2) Use for all outputs? Make setting, see Fct. A4.1 above!
A4.4	low flow cutoff	1) Setting for main current output (sets output value to "0") Setting: x.xxx ± x.xxx% (range: 0.0...20%) (1st value = switching point / 2nd value = hysteresis), condition: 2nd value ≤ 1st value 2) Use for all outputs? Make setting, see Fct. A4.1 above!
A4.5	time constant	1) Setting for main current output (applicable to all flow measurements) Setting: xxx.x s (range: 000.1...100 s) 2) Use for all outputs? Make setting, see Fct. A4.1 above!

#### A4 station address (only for PROFIBUS)

A4	station address	Setting of device address. The functions are described in detail in the supplementary instructions.
----	-----------------	--



No.	Function	Setting / Description
-----	----------	-----------------------

#### A4 slave address (only for MODBUS)

A4	slave address	Setting of device address. The functions are described in detail in the supplementary instructions.
----	---------------	--

#### A5 digital outputs (only for HART®)

A5	digital outputs	Valid for pulse output (terminal D) and counter 1.
A5.1	measurement	1) Select the "measurement": volume flow / mass flow 2) Use for all outputs? (also use this setting for Fct. A5.2...A5.4!) Setting: no (only for pulse output D) / yes (for all digital outputs)
A5.2	pulse value unit	Selection of the unit from a list, depending on the measurement
A5.3	value p. pulse	1) Setting for pulse output D (volume or mass value per pulse) Setting: xxx.xxx in l or kg or in the unit selected in A5.2 2) Use for all outputs? Make setting, see Fct. A5.1 above!
A5.4	low flow cutoff	1) Setting for pulse output D (sets output value to "0") Setting: x.xxx ± x.xxx% (range: 0.0...20%) (1st value = switching point / 2nd value = hysteresis), condition: 2nd value ≤ 1st value 2) Use for all outputs? Make setting, see Fct. A5.1 above!

#### A7 process input

A7.1	device serial no.	Shows the serial no. of the system.
The following process input parameters are only available, if the quick access has been activated in the menu "setup / device / quick setup".		
A7.2	zero calibration	Display of actual zero calibration value. Query: calibrate zero? Settings see Fct. C1.1.1.
A7.3	size	Select from the size table.
A7.5	GKL	Set value acc. to information on nameplate; range: 0.5...20
A7.6	coil resistance Rsp	Field coil resistance at 20°C; range: 10.00...220 Ω
A7.7	calib. coil temp.	The coil temperature is derived from the coil resistance at the reference temperature. Settings see Fct. C1.1.8.
A7.8	target conduct.	Reference value for on-site calibration; range: 1.000...50000 μS/cm
A7.9	EF electr. factor	For calculation of the conductivity based on the electrode impedance. Settings see Fct. C1.1.11.
A7.10	field frequency	Setting as on the nameplate of the measuring sensor = line frequency x value (from the following list): 1/2; 1/4; 1/6; 1/8; 1/12; 1/18; 1/36; 1/50
A7.11	flow direction	Define the polarity of the flow direction. Select: normal direction (according to the arrow on the measuring sensor) / reverse direction (in the opposite direction to the arrow)

## 6.3.2 Menu B, test

No.	Function	Setting / Description
-----	----------	-----------------------

## B1 simulation

B1	simulation	The displayed values are simulated.
B1.1	flow speed	Simulation of the flow speed.
		Select: break (exit function without simulation) / set value (range: -12...+12 m/s; unit selection in Fct. C5.7.7)
		Query: start simulation? Settings: no (exit function without simulation) / yes (start simulation)
B1.2	volume flow	Simulation of volume flow, sequence and settings similar to B1.1, see above!
B1._	current out X	[_ stands for Fct. B1.3...1.6]
B1._	pulse output X	simulation X
B1._	frequency out X	[X stands for one of the connection terminals A, C or D]
B1._	control input X	Sequence and settings similar to B1.1, see above!
B1._	limit switch X	For the pulse output the set number of pulses are displayed once in a second!
B1._	status output X	

## B2 actual values

B2	actual values	Display of actual values; Exit the displayed function with the ↵ key.
B2.1	operating hours	Display the actual operating hours; Exit the displayed function with the ↵ key.
B2.2	act. flow speed	Display the actual flow speed; Exit the displayed function with the ↵ key.
B2.3	act. coil temp.	See also Fct. C1.1.7...C1.1.8.
B2.4	electr. temperature	Display the actual electronics temperature; exit the displayed function with the ↵ key.
B2.5	act. conductivity	See also Fct. C1.3.1...C1.3.2
B2.6	act. electr. noise	See also Fct. C1.3.13...C1.3.15
B2.8	act. coil resistance	Display the actual resistance of the field coils.

**B3 information**

B3	information	LC display (this format description is only valid for B3.2....3.5 and B3.8) 1st line: ID no. of the circuit board 2nd line: software version 3rd line: production date
B3.1	C number	CG number, cannot be changed (input/output version)
B3.2	process input	Process input part of the electronics
B3.3	SW.REV.MS	Information about the main software
B3.4	SW.REV.UIS	Information about the user interface software of the measuring device
B3.5	"bus interface"	Only appears with Profibus, Modbus and FF and shows the information about the corresponding interface software.
B3.6	device serial no.	Serial no. of the system
B3.7	electronic serial no.	Serial number of the electronics assembly
B3.8	Electronic Revision ER	Reference identification number, electronic revision and production date of the device; includes all hardware and software changes

## 6.3.3 Menu C, setup

No.	Function	Settings / descriptions
-----	----------	-------------------------

## C1 process input

## C1.1 calibration

C1.1	calibration	Grouping of all functions related to measuring sensor calibration.
C1.1.1	zero calibration	Display of actual zero calibration value. calibrate zero? Select: break (return with ← key) standard (factory setting) / manual (display last value, set new value, range: -1.00...+1 m/s) / automatic (shows the current value as the new zero calibration value)
C1.1.2	size	Select from the size table.
C1.1.5	GKL	Set value acc. to the information on the nameplate. Range: 0.5...20
C1.1.7	coil resistance Rsp	Field coil resistance at 20°C. Range: 10.00...220 Ω
C1.1.8	calib. coil temp.	The coil temperature is derived from the coil resistance at the reference temperature. Set coil temperature: break (return with ← key) / standard (= 20°C) / automatic (set current temperature); range: -40.0...+200°C Set coil resistance: break (return with ← key) / standard (= setting of Fct. C1.1.7) / automatic (= calibration with the current resistance)
C1.1.9	density	Calculation of the mass flow with constant product density. Range: 0.1...5 kg/l
C1.1.10	target conduct.	Reference value for on-site calibration. Range: 1.000...50000 µS/cm
C1.1.11	EF electr. factor	Factor for the calculation of the conductivity based on the electrode impedance. Query: calibrate EF? Select: break (return with ← key) / standard (with factory setting) / manual (set desired value) / automatic (determines EF according to the setting in Fct. C1.1.10)
C1.1.13	field frequency	Setting as on the nameplate of the measuring sensor. = line frequency x value (from the following list): 1/2; 1/4; 1/6; 1/8; 1/12; 1/18; 1/36; 1/50
C1.1.14	select settling	Mode of the settling time (special function). Select: standard (fixed allocation) / manual (manual time setting for the settling time for the field current)
C1.1.15	settling time	Only when "manual" selected in Fct. C1.1.14; range: 1.0...250 ms

No.	Function	Settings / descriptions
C1.1.16	line frequency	Setting the line frequency to one value. Select: 50 Hz / 60 Hz
C1.1.17	act. coil resistance	Display of the actual resistance of the field coil.

## C1.2 filter

C1.2	filter	Grouping of all functions related to filter of measuring sensor electronics.
C1.2.1	limitation	Limitation of all flow values, before smoothing by time constant; affects all outputs.
		Settings: -xxx.x / +xxx.x m/s; condition: 1st value < 2nd value
		Range 1st value: -100.0 m/s ≤ value ≤ -0.001 m/s
		Range 2nd value: +0.001 m/s ≤ value ≤ +100 m/s
C1.2.2	flow direction	Define the polarity of the flow direction.
		Select: normal direction (according to the arrow on the measuring sensor) / reverse direction (in the opposite direction to the arrow)
C1.2.3	time constant	For all flow measurements and outputs.
		xxx.x s; range: 0.0...100 s
C1.2.4	pulse filter	Suppresses disturbances due to solids, air/gas bubbles and sudden changes in pH.
		Select: off (without pulse filter) / on (with pulse filter) / automatic (with new pulse filter)
		<b>Pulse filter "on"</b> : The change from one measurement value to the next one is limited to the value "pulse limitation" for the total time "pulse width". This filter allows a faster signal tracking for slowly changing flow values.
		<b>Pulse filter "automatic"</b> : The raw flow values are collected into a buffer, covering two times the "pulse width" values. This filter is called "median" filter. This filter allows a better suppression of pulse shaped disturbances (particles or air bubbles in very noisy environment).
C1.2.5	pulse width	Length of interference and delays to be suppressed on sudden changes in flow.
		Only available, if the pulse filter is set to "on" or "automatic" in Fct. C1.2.4.
		xx.x s; range for "on": 0.01...10 s or for "automatic": 0.1...20 s
C1.2.6	pulse limitation	Dynamic limitation from one measured value to the next; only if the pulse filter is set to "on" in Fct. C1.2.4.
		xx.x s; range: 0.01...100 m/s
C1.2.7	noise filter	Suppresses noise at low conductivity, high solids content, air and gas bubbles, and chemically inhomogeneous media.
		Select: off (without noise filter) / on (with noise filter)
C1.2.8	noise level	Range within which changes are evaluated as noise, and outside of which changes are evaluated as flow (only if the noise filter is set to "on" in Fct. C1.2.7).
		xx.xx m/s; range: 0.01...10 m/s
C1.2.9	noise suppression	Set noise suppression (only if the noise filter is set to "on" in Fct. C1.2.7).
		Range: 1...10; noise suppression factor [min = 1...max = 10]

No.	Function	Settings / descriptions
C1.2.10	low flow cutoff	Sets low flow values to "0"; affects all outputs.
		$x.xxx \pm x.xxx$ m/s (ft/s); range: 0.0...20 m/s (0.0...65.6 ft/s)
		(1st value = switching point / 2nd value = hysteresis), condition: 2nd value $\leq$ 1st value
C1.2.11	conductivity	Setting the time constant for the conductivity measurement; only available, if the conductivity measurement is activated in Fct. C1.3.1.

### C1.3 self test

C1.3	self test	Grouping of all functions related to self test of measuring sensor electronics.
C1.3.1	empty pipe	Switch conductivity measurement off and on (measurement of the electrode resistance with or without empty pipe detection).
		Select: off / conductivity (only conductivity measurement) / cond. + empty pipe [F] (conductivity measurement and empty pipe indication, error category [F] application); Flow indication "= 0" when "empty pipe" /
		cond. + empty pipe [S] (conductivity measurement and empty pipe indication, error category [S] measurement out of specification); Flow indication "= 0" when "empty pipe" /
		cond. + empty pipe [I] (conductivity measurement and empty pipe indication, error category [I] information); Flow indication "= 0" when "empty pipe"
C1.3.2	limit empty pipe	Only available if "empty pipe [...]" is activated in Fct. C1.3.1.
		Range: 0.0...9999 $\mu$ S (set about 50% of the lowest occurring conductivity in operation. Conductivity below this value means a signal as "empty pipe").
C1.3.3	act. conductivity	Only available if "empty pipe [...]" is activated in Fct. C1.3.1.
		Actual conductivity is indicated. Activation takes place only after setting mode is exited!
C1.3.13	electrode noise	Switch the automatic test off or on.
		Select: off / on
C1.3.14	limit electr. noise	Only with activated electrode noise (see Fct. C1.3.13).
		Range: 0.000...12 m/s
		Noise above this threshold generates an error of category [S].
C1.3.15	act. electr. noise	Only available if the electrode noise is set to "on" in Fct. C1.3.13. Activation takes place only after setting mode is exited!
C1.3.16	settling of field	Automatic test switched off / on.
		Select: off / on
C1.3.17	diagnosis value	Select diagnosis value for testing the various analogue outputs.
		Select: off (no diagnosis) / electrode noise (activate in Fct. C1.3.13) / terminal 2 DC (electrode DC voltage at electrode terminal 2) / terminal 3 DC (electrode DC voltage at electrode terminal 3)

**C1.4 information**

C1.4	information	Grouping of all functions related to information with respect to measuring sensor and sensor electronics.
C1.4.1	liner	Shows the material of the liner.
C1.4.2	electr. material	Shows the material of the electrodes.
C1.4.3	calibration date	Shows the date on which the measuring sensor was calibrated.
C1.4.4	serial no. sensor	Shows the serial no. of the measuring sensor.
C1.4.5	V no. sensor	Shows the order number of the measuring sensor.
C1.4.6	sensor electr. info	Shows the serial number of the circuit board, the software version number and the calibration date of the circuit board.

**C1.5 simulation**

C1.5	simulation	Grouping of all functions for simulating measuring sensor values.
		These simulations have effect on all outputs, including counters and display.
C1.5.1	flow speed	Sequence see Fct. B1.1
C1.5.2	volume flow	Sequence see Fct. B1.2

No.	Function	Settings / descriptions
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**C2 I/O (Inputs/Outputs)****C2.1 hardware**

C2.1	hardware	Configuration of connection terminals.
		Selection depends on signal converter version.
C2.1.1	terminal A	Select: off (switched off) / current output
C2.1.3	terminal C	Select: off (switched off) / current output / status output / limit switch / control input
C2.1.4	terminal D	Select: off (switched off) / frequency output / pulse output / status output / limit switch

**C2.\_ current out X**

C2._	current out X	X stands for connection terminals A
		_ stands for Fct. C2.2 (A)
C2._1	range 0%...100%	Current range for the selected "measurement", e.g. 4...20 mA, corresponds to 0...100%
		xx.x ... xx.x mA; range: 0.00...20 mA
		Condition: $0 \text{ mA} \leq 1\text{st value} \leq 2\text{nd value} \leq 20 \text{ mA}$
C2._2	extended range	Min. and max. limits of current values. If the current range is exceeded, the current is set to these limits.
		xx.x ... xx.x mA; range: 03.5...21.5 mA
		Condition: $0 \text{ mA} \leq 1\text{st value} \leq 2\text{nd value} \leq 21.5 \text{ mA}$ and out of current range
C2._3	error current	Specify error current.
		xx.x mA; range: 3...22 mA
		Condition: outside of extended range

No.	Function	Settings / descriptions
C2._4	error condition	The following error conditions can be selected: error in device (error category [F]) / application error (error category [F]) / out of specification (error category [S])
C2._5	measurement	Measurements for activating the output.
		Select: volume flow / mass flow / diagnosis value / flow speed / coil temperature / conductivity
C2._6	range	0...100% of the "measurement" set in Fct. C2._5.
		x.xx...xx.xx _ _ _ (format and unit depend on the "measurement", see above)
C2._7	polarity	Set polarity; please note flow direction in C1.2.2!
		Select: both polarities (plus and minus values are displayed) / positive polarity (display for negative values = 0) / negative polarity (display for positive values = 0) / absolute value (always displays positive, with both negative and positive values)
C2._8	limitation	Limitation before applying the time constant.
		±xxx ... ±xxx%; range: -150...+150%
C2._9	low flow cutoff	Sets the measurement to "0" for low values.
		x.xxx ± x.xxx%; range: 0.0...20%
		1st value = switching point / 2nd value = hysteresis; condition: 2nd value ≤ 1st value
C2._10	time constant	Range: 000.1...100 s
C2._11	special function	Select: off (switched off) / automatic range (range is changed automatically, extended lower range; the magnifying function in the extended lower range, only makes sense in combination with a status output) /
C2._12	threshold	Appears only when Fct. C2._11 "threshold" is activated between extended and normal range. The automatic range function always changes from the extended to the normal range when the 100% current is reached. The upper 100% value of the hysteresis is then = 0. The threshold is then the hysteresis value, instead of "threshold ± hysteresis" as shown in the display.
		Range: 5.0...80%
		1st value = switching point / 2nd value = hysteresis; condition: 2nd value ≤ 1st value
C2._13	information	Information about serial no. of the I/O board, software version no. and production date of the circuit board.
C2._14	simulation	Sequence see B1._ current output X
C2._15	4mA trimming	Trimming of the current at 4 mA.
		Reset to 4 mA restores the factory calibration.
		Used for HART® setting.
C2._16	20mA trimming	Trimming of the current at 20 mA.
		Reset to 20 mA restores the factory calibration.
		Used for HART® setting.



## C2.\_ frequency out X

C2._	frequency out X	X stands for connection terminals D _ stands for Fct. C2.5 (D)
C2._1	pulse shape	Specify the pulse shape. Select: symmetric (about 50% on and 50% off) / automatic (constant pulse width about 50% on and 50% off at 100% pulse rate) / fixed (fixed pulse rate, setting see below Fct. C2._3 "100% pulse rate")
C2._2	pulse width	Only available if "fixed" is set in Fct. C2._1. Range: 0.05...2000 ms Note: max. setting value $T_p$ [ms] $\leq$ 500 / max. pulse rate [1/s], gives the pulse width = time where the output is activated
C2._3	100% pulse rate	Pulse rate for 100% of the measuring range. Limitation is at 120% of this pulse rate or at $1/(1.5 * \text{pulse width})$ whatever is lower. Range: 1...10000 Hz
C2._4	measurement	Measurements for activating the output. Select: volume flow / mass flow / diagnosis value / flow speed / coil temperature / conductivity
C2._5	range	0...100% of the "measurement" set in Fct. C2._4 x.xx...xx.xx _ _ _ (format and unit depend on the measurement, see above)
C2._6	polarity	Set polarity; please note flow direction in C1.2.2! Select: both polarities (plus and minus values are displayed) / positive polarity (display for negative values = 0) / negative polarity (display for positive values = 0) / absolute value (always displays positive, with both negative and positive values)
C2._7	limitation	Limitation before applying the time constant. $\pm$ xxx ... $\pm$ xxx%; range: -150...+150%
C2._8	low flow cutoff	Sets the measurement to "0" for low values. x.xxx $\pm$ x.xxx%; range: 0.0...20% 1st value = switching point / 2nd value = hysteresis; condition: 2nd value $\leq$ 1st value
C2._9	time constant	Range: 000.1...100 s
C2._10	invert signal	Select: off (activated output: switch closed) / on (activated output: switch open)
C2._12	information	Information about serial no. of the I/O board, software version no. and production date of the circuit board.
C2._13	simulation	Sequence see B1._ frequency out X

## C2.\_ pulse output X

C2._	pulse output X	X stands for connection terminals D _ stands for Fct. C2.5 (D)
C2._1	pulse shape	Specify the pulse shape. Select: symmetric (about 50% on and 50% off) / automatic (constant pulse width of 50% on and 50% off at max. pulse rate) / fixed (fixed pulse rate, setting see below Fct. C2._3 "max. pulse rate")
C2._2	pulse width	Only available if "fixed" is set in Fct. C2._1. Range: 0.05...2000 ms Note: max. setting value $T_p$ [ms] $\leq$ 500 / max. pulse rate [1/s], gives the pulse width = time where the output is activated For pulse widths below 0.5 seconds the max. pulse rate has to be adjusted to $1/(2 * \text{pulse width})$ to prevent overrange messages.
C2._3	max. pulse rate	Maximum pulse rate. Limitation is at 120% of this pulse rate or at $1/(1.5 * \text{pulse width})$ whatever is lower. Range: 1...10000 Hz
C2._4	measurement	Measurements for activating the output. Select: volume flow / mass flow
C2._5	pulse value unit	Selection of the unit from a list, depending on the "measurement"
C2._6	value p. pulse	Set value for volume or mass per pulse. xxx.xxx, measured value in [l] or [kg] depending on setting in C2._5
C2._7	polarity	Set polarity; please note flow direction in C1.2.2! Select: both polarities (plus and minus values are displayed) / positive polarity (display for negative values = 0) / negative polarity (display for positive values = 0) / absolute value (always displays positive, with both negative and positive values)
C2._8	low flow cutoff	Sets the measurement to "0" for low values. x.xxx $\pm$ x.xxx%; range: 0.0...20% 1st value = switching point / 2nd value = hysteresis; condition: 2nd value $\leq$ 1st value
C2._9	time constant	Range: 000.1...100 s
C2._10	invert signal	Select: off (activated output: switch closed) / on (activated output: switch open)
C2._12	information	Information about serial no. of the I/O board, software version no. and production date of the circuit board.
C2._13	simulation	Sequence see B1._ pulse output X

## C2.\_ status output X

C2._	status output X	X (Y) stands for one of the connection terminals C or D _ stands for Fct. C2.4 (C) / C2.5 (D)
C2._1	mode	The output shows the following measuring conditions: out of specification (output set, signals status of category "error in device" or "application error" or "out of specification" refer to <i>Status messages and diagnostic information</i> on page 77) / application error (output set, signals status of the category "error in device" or "application error" refer to <i>Status messages and diagnostic information</i> on page 77) / polarity flow (polarity of the current flow) / over range flow (over range of the flow) / counter 1 preset (activates when counter X preset value is reached) / counter 2 preset (activates when counter X preset value is reached) / output A (activated by the status of output Y, additional output data see below) / output C (activated by the status of output Y, additional output data see below) / output D (activated by the status of output Y, additional output data see below) / off (switched off) / empty pipe (when pipe empty, output activated) / error in device (output set, signals status of the category "error in device" refer to <i>Status messages and diagnostic information</i> on page 77)
C2._2	current output Y	Only appears if output A or C is set under "mode" and this output is a "current output". Select: polarity (is signalled) / over range (is signalled) / automatic range (signals lower range)
C2._2	frequency out Y and pulse output Y	Only appears if output D is set under "mode" and this output is a "frequency output" or "pulse output". Select: polarity (is signalled) / over range (is signalled)
C2._2	status output Y	Only appears if output C or D is set under "mode" and this output is a "status output". Select: same signal (like other connected status output, signal can be inverted, see below)
C2._2	limit switch Y	Only appears if output C or D is set under "mode" and this output is a "limit switch". Select: status off (is always selected here if "status output X" is connected with a limit switch)
C2._2	off	Only appears if output A, C or D is set under "mode" and this output is switched off.
C2._3	invert signal	Select: off (activated output: switch closed) / on (activated output: switch open)
C2._4	information	Serial no. of the I/O board, software version no. and production date of the circuit board
C2._5	simulation	Sequence see B1._ status output X

## C2.\_ limit switch X

C2._	limit switch X	X stands for one of the connection terminals C or D _ stands for Fct. C2.4 (C) / C2.5 (D)
C2._1	measurement	Select: volume flow / mass flow / diagnosis value / flow speed / coil temperature / conductivity
C2._2	threshold	Switching level, set threshold with hysteresis. xxx.x $\pm$ x.xxx (format and unit depend on the measurement, see above) 1st value = threshold / 2nd value = hysteresis; condition: 2nd value $\leq$ 1st value
C2._3	polarity	Set polarity; please note flow direction in C1.2.2! Select: both polarities (plus and minus values are displayed) / positive polarity (display for negative values = 0) / negative polarity (display for positive values = 0) / absolute value (always displays positive, with both negative and positive values)
C2._4	time constant	Range: 000.1...100 s
C2._5	invert signal	Select: off (activated output: switch closed) / on (activated output: switch open)
C2._6	information	Information about serial no. of the I/O board, software version no. and production date of the circuit board.
C2._7	simulation	Sequence see B1._ limit switch X

## C2.4 control input C

C2.4.1	mode	Definition of the control input. off (control input switched off) / hold all outputs (hold current values, not display and counters) / output X (hold current values) / all outputs to zero (current values = 0%, not display and counters) / output X to zero (current value = 0%) / reset all counters (reset all counters to "0") / reset counter X (only counter X (1 or 2) is reset to "0") / stop all counters / stop counter X (stop only counter X (1 or 2) / zero outp.+stop Cnt. (all outputs to "0", stop all counters, not the display) / error reset (all resettable errors are deleted)
C2.4.2	invert signal	Select: off (control input is activated when a current is applied at the input (by voltage to passive inputs or a low-value resistor to active inputs)) / on (control input is activated when no current is applied at the input (low voltage to passive inputs or a high-value resistor to active inputs))
C2.4.3	information	Serial no. of the I/O board, software version no. and production date of the circuit board
C2.4.4	simulation	Sequence see B 1._ control input X

No.	Function	Settings / descriptions
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### C3 I/O counter (HART® or Modbus)

C3.1	counter 1	Set function of counter.
C3.2	counter 2	_ stands for 1, 2 (= counter 1, 2) The basic version (standard) has only 2 counters! These functions are only available for HART® devices.
C3._1	function	Select: sum counter (counts positive + negative values) / + counter (counts only the positive values) / - counter (counts only the negative values) / off (counter is switched off)
C3._2	measurement	Selection of the "measurement" for counter _. Select: volume flow / mass flow
C3._3	low flow cutoff	Sets low flow values to "0". Range: 0.0...20% 1st value = switching point / 2nd value = hysteresis; condition: 2nd value ≤ 1st value
C3._4	time constant	Range: 000.1...100 s
C3._5	preset value	If this value is reached, positive or negative, a signal is generated that can be used for a status output. For this status output the "preset counter X" has to be set. Preset value (max. 8 digits) x.xxxxx in selected unit (see C5.7.10 and C5.7.13).
C3._6	reset counter	Sequence see Fct. A3.2 and A3.3.
C3._7	set counter	Set counter _ to the desired value. Select: break (exit function) / set value (opens the editor to make the entry) Query: set counter? Select: no (exit function without setting the value) / yes (sets the counter and exits the function)
C3._8	stop counter	Counter _ stops and holds the current value. Select: no (exit the function without stopping the counter) / yes (stop the counter and exit the function)
C3._9	start counter	Start the counter _, after this counter was stopped. Select: no (exit the function without starting the counter) / yes (start the counter and exit the function)
C3._10	information	Serial no. of the I/O board, software version no. and production date of the circuit board

### C3 I/O counter (Profibus)

For the detailed description of the Profibus functions refer to the corresponding supplementary instructions.

No.	Function	Settings / descriptions
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#### C4 I/O HART (only for HART® devices)

C4	I/O HART	Selection or display of the 4 dynamic variables (DV) for HART®.
		The HART® current output (terminal A for basic I/O or terminal C for Exi I/O) always has a fixed link to the primary variables (PV).
		Fixed links of the other DVs (1-3) are only possible if one additional analogue output (frequency output) is available. If not, the "measurement" can be freely selected from the following list: flow speed / volume flow / mass flow / diagnosis value / coil temperature / conductivity / counter 1 / counter 2 / operating hours
		X stands for connection terminals A, C and D _ stands for 1, 2, 3 or 4
C4.1	PV is	Current output (primary variable)
C4.2	SV is	(secondary variable)
C4.3	TV is	(tertiary variable)
C4.4	4V is	(4th variable)
C4.5	HART units	Function to make the change of the units for the DVs (dynamic variables) possible.
		Select: break (return with ↵ key) / HART® display (copies the settings for the display units to the settings for the DVs) / load defaults (resets the DVs to the factory defaults)
C4._1	current output X	Shows the current analogue measured value of the linked current output. The "measurement" cannot be changed!
C4._1	frequency out X	Shows the current analog measured value of the linked frequency output, if present. The "measurement" cannot be changed!
C4._1	HART dynamic var.	Measurements of the dynamic variables for HART®.
		Select: flow speed / volume flow / mass flow / diagnosis value / coil temperature / conductivity / counter 1 / counter 2 / operating hours

#### C4 I/O Profibus (only for Profibus devices)

For the detailed description of the Profibus functions refer to the corresponding supplementary instructions.

No.	Function	Settings / descriptions
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## C5 device

### C5.1 device info

C5.1	device info	Grouping of all functions that have no direct effect on the measurement or any output.
C5.1.1	Tag	Settable characters (max. 8 digits): A...Z; a...z; 0...9; / - , .
C5.1.2	C number	CG number, cannot be changed; describes the signal converter version
C5.1.3	device serial no.	Serial no. of the system; cannot be changed.
C5.1.4	electronic serial no.	Serial no. of the electronic assembly; cannot be changed.
C5.1.5	SW.REV.MS	Serial no. of the circuit board, version no. of the main software, production date of the circuit board
C5.1.6	Electronic Revision ER	Reference identification number, electronic revision and production date of the device Includes all hardware and software changes.

### C5.2 display

C5.2	display	-
C5.2.1	language	Language selection depends on the device version.
C5.2.2	contrast	At extreme temperatures the contrast on the display can be adjusted. Setting: -9...0...+9
		This change takes place immediately, not just when setting mode is exited!
C5.2.3	default display	Specification of the default display page that is returned to after a short delay period.
		Select: none (current page is always active) / 1. meas. page (shows this page) / 2. meas. page (shows this page) / status page (shows only status messages) / graphic page (trend of the 1st measurement)
C5.2.5	SW.REV.UIS	Serial no. of the circuit board, version no. of user interface software, production date of the circuit board

## C5.3 1. meas. page &amp; C5.4 2. meas. page

C5.3	1. meas. page	_ stands for 3 = 1. meas. page and 4 = 2. meas. page
C5.4	2. meas. page	
C5._1	function	Specify the number of measured value lines (font size).
		Select: one line / two lines / three lines
C5._2	measurement 1.line	Specify the "measurement" for the 1st line.
		Select: volume flow / mass flow / diagnosis value / flow speed / coil temperature / conductivity
C5._3	range	0...100% of the "measurement" set in Fct. C5._2.
		x.xx...xx.xx _ _ _ (format and unit depend on the "measurement")
C5._4	limitation	Limitation before applying the time constant
		±xxx...±xxx%; range: -120...+120%
C5._5	low flow cutoff	Sets low flow values to "0".
		x.xxx ± x.xxx %; range: 0.0...20 %
		1st value = switching point / 2nd value = hysteresis; condition: 2nd value ≤ 1st value
C5._6	time constant	Range: 0.1...100 s
C5._7	format 1.line	Specify decimal places.
		Select: automatic (adaptation is automatic) / X (= none) ...X.XXXXXXXXXX (max. 8 digits)
C5._8	measurement 2.line	Specify measurement 2.line (only available if this 2.line is activated)
		Select: bar graph (for the measurement selected in 1.line) / volume flow / mass flow / diagnosis value / flow speed / counter 1 / counter 2 / conductivity / coil temperature / operating hours
C5._9	format 2.line	Specify position after decimal point (only available if this 2.line is activated).
		Select: automatic (adaptation is automatic) / X (= none) ...X.XXXXXXXXXX (max. 8 digits)
C5._10	measurement 3.line	Specify measurement 3.line (only available if this 3.line is activated).
		Select: volume flow / mass flow / diagnosis value / flow speed / coil temperature / conductivity / counter 1 / counter 2 / operating hours
C5._11	format 3.line	Specify position after decimal point (only available if this 3.line is activated).
		Select: automatic (adaptation is automatic) / X (= none) ...X.XXXXXXXXXX (max. 8 digits)



## C5.5 graphic page

C5.5	graphic page	This page always shows trend curve of the "measurement" of the 1. meas. page / 1.line (see Fct. C5.3.2).
C5.5.1	select range	Select: manual (set range in Fct. C5.5.2) / automatic (automatic depiction based on the measured values) Reset only after parameter change or after switching off and on.
C5.5.2	range	Set the scaling for the Y axis. Only available if "manual" is set in C5.5.1. $\pm xxx \pm xxx\%$ ; range: -100...+100% 1st value = lower limit / 2nd value = upper limit; condition: 1st value $\leq$ 2nd value
C5.5.3	time scale	Set the time scaling for the X axis (trend curve). xxx min; range: 0...100 min

## C5.6 special functions

C5.6	special functions	-
C5.6.1	reset errors	reset errors? Select: no / yes
C5.6.2	save settings	Save current settings. Select: break (exit function without saving) / backup 1 (saves the settings in the backup 1 storage place) / backup 2 (saves the settings in the backup 2 storage place) Query: go on with copy? (cannot be undone) Select: no (exit the function without saving) / yes (copy current settings to storage backup 1 or backup 2)
C5.6.3	load settings	Load saved settings. Select: break (exit function without loading) / factory settings (reload factory settings) / backup 1 (loads the settings from the backup 1 storage place) / backup 2 (loads the settings from the backup 2 storage place) / load sensor data (restore factory setting of the values for the measuring sensor. Display and I/O settings are retained!) Query: go on with copy? (cannot be undone) Select: no (exit the function without saving) / yes (load data from the selected storage place)
C5.6.4	password quick set	Password required to change data in the menu "quick setup". 0000 (= to this menu without password) xxxx (password required); range (4 digits): 0001...9999
C5.6.5	password setup	Password required to change data in the menu "setup". 0000 (= to this menu without password) xxxx (password required); range (4 digits): 0001...9999

## C5.7 units

C5.7	units	-
C5.7.1	volume flow	m <sup>3</sup> /h; m <sup>3</sup> /min; m <sup>3</sup> /s; L/h; L/min; L/s (L = litres); cf/h; cf/min; cf/s; gal/h; gal/min; gal/s; IG/h; IG/min; IG/s; free unit (set factor and text in the next two functions, sequence see below)
C5.7.2	text free unit	For text to be specified refer to <i>Set free units</i> on page 76:
C5.7.3	[m <sup>3</sup> /s]*factor	Specification of the conversion factor, based on m <sup>3</sup> /s: xxx.xxx refer to <i>Set free units</i> on page 76
C5.7.4	mass flow	kg/s; kg/min; kg/h; t/min; t/h; g/s; g/min; g/h; lb/s; lb/min; lb/h; ST/min; ST/h (ST = Short Ton); LT/h (LT = Long Ton); free unit (set factor and text in the next two functions, sequence see below)
C5.7.5	text free unit	For text to be specified refer to <i>Set free units</i> on page 76:
C5.7.6	[kg/s]*factor	Specification of the conversion factor, based on kg/s: xxx.xxx refer to <i>Set free units</i> on page 76
C5.7.7	flow speed	m/s; ft/s
C5.7.8	conductivity	µS/cm; S/m
C5.7.9	temperature	°C; °F; K
C5.7.10	volume	m <sup>3</sup> ; L; hL; mL; gal; IG; in <sup>3</sup> ; cf; yd <sup>3</sup> ; free unit (set factor and text in the next two functions, sequence see below)
C5.7.11	text free unit	For text to be specified refer to <i>Set free units</i> on page 76:
C5.7.12	[m <sup>3</sup> ]*factor	Specification of the conversion factor, based on m <sup>3</sup> : xxx.xxx refer to <i>Set free units</i> on page 76
C5.7.13	mass	kg; t; mg; g; lb; ST; LT; oz; free unit (set factor and text in the next two functions, sequence see below)
C5.7.14	text free unit	For text to be specified refer to <i>Set free units</i> on page 76:
C5.7.15	[kg]*factor	Specification of the conversion factor, based on kg: xxx.xxx refer to <i>Set free units</i> on page 76
C5.7.16	density	kg/L; kg/m <sup>3</sup> ; lb/cf; lb/gal; free unit (set factor and text in the next two functions, sequence see below)
C5.7.17	text free unit	For text to be specified refer to <i>Set free units</i> on page 76:
C5.7.18	[kg/m <sup>3</sup> ]*factor	Specification of the conversion factor, based on kg/m <sup>3</sup> : xxx.xxx refer to <i>Set free units</i> on page 76

**C5.8 HART**

C5.8	HART	This function is only available for devices with a HART® interface!
C5.8.1	HART	Switch the HART® communication on or off.
		Select: on (HART® activated); possible current range for current output 4...20 mA / off (HART® not activated); possible current range for current output 0...20 mA
C5.8.2	address	Set address for HART® operation.
		Select: 00 (point-to-point operation, current output has normal function) / 01...15 (multi-drop operation, current output is set to the 0% value)
C5.8.3	message	Set required text: A...Z ; a...z ; 0...9 ; / - + , . *
C5.8.4	description	Set required text: A...Z ; a...z ; 0...9 ; / - + , . *

**C5.8 physic. block (only for Profibus devices)**

For the detailed description of the Profibus functions refer to the corresponding supplementary instructions.

**C5.8 Foundation Fieldbus (only for Foundation Fieldbus devices)**

For the detailed description of the Foundation Fieldbus functions refer to the corresponding supplementary instructions.

**C5.8 RS485/Modbus (only for Modbus devices)**

For the detailed description of the Modbus functions refer to the corresponding supplementary instructions.

**C5.9 quick setup**

C5.9	quick setup	Activate quick access in the menu "quick setup". Default: "quick setup" is active (yes)
		Select: yes (activated) / no (not activated)
C5.9.1	reset counter 1	Reset of counter 1 can be activated or deactivated.
		Select: yes (activated) / no (not activated)
C5.9.2	reset counter 2	Reset of counter 2 can be activated or deactivated.
		Select: yes (activated) / no (not activated)
C5.9.4	process input	Activate quick access to the important process input parameters.
		Select: yes (activated) / no (not activated)

### 6.3.4 Set free units

Free units	Sequences to set texts and factors
<b>Texts</b>	
Volume flow, mass flow and density:	3 digits before and after the slash xxx/xxx (max. 6 characters plus a "/")
Permissible characters:	A...Z; a...z; 0...9; / - + , . *; @ \$ % ~ () [] _
<b>Conversion factors</b>	
Desired unit	= [unit see above] * conversion factor
Conversion factor	Max. 9 digits
Shift decimal point:	↑ to the left and ↓ to the right

## 6.4 Description of functions

### 6.4.1 Reset counter in the menu "quick setup"



**INFORMATION!**

*It may be necessary to activate resetting of the counter in the menu "quick setup".*

Key	Display	Description and setting
>	quick setup	Press and hold for 2.5 s, then release the key.
>	language	-
2 x ↓	reset	-
>	reset errors	-
↓	counter 1	Select desired counter.
↓	counter 2	
>	reset counter no	-
↓ or ↑	reset counter yes	-
←	counter 1, 2	Counter has been reset.
3 x ←	Measuring mode	-

### 6.4.2 Deleting error messages in the menu "quick setup"



**INFORMATION!**

For the detailed list of the possible error messages refer to Status messages and diagnostic information on page 77.

Key	Display	Description and setting
>	quick setup	Press and hold for 2.5 s, then release the key.
>	language	-
2 x ↓	reset	-
>	reset errors	-
>	reset? no	-
↓ or ↑	reset? yes	-
←	reset errors	Error has been reset.
3 x ←	Measuring mode	-

### 6.5 Status messages and diagnostic information



**INFORMATION!**

As status message always the name of the relevant status group and the status signal is displayed.

Each status message (= status signal) has a specific symbol, determined by NAMUR, which is displayed with the message. The length of each message is limited to one line.

Symbol	Symbol background colour	Letter	Status signal	Description and consequence
	white	<b>F</b> (bold)	Error in device	No measurement possible.
	blue	F	Application error	No measurement possible due to process/application conditions. The device is still OK.
	blue	S	Out of specification	Measurements are available but are no longer sufficiently accurate and should be checked.
	blue	C	Checks in progress	A test function is active. The displayed or transferred measured value does not correspond to the actual measured value.
-	-	I	Information	No direct influence on the measurements.

## Operational faults in device

Messages on the display	Description	Actions
Status: F _ _ _ _ _	<b>Operational fault in device, mA output <math>\leq</math> 3.6 mA or set fault current (depending on the seriousness of the fault), status output open, pulse / frequency output: no pulses</b>	<b>Repair necessary.</b>
F error in device	Error or failure of device. Parameter or hardware error. No measurement possible.	Group message, when one of the following or some other severe error occurs.
F IO 1	Error, operational fault in IO 1. Parameter or hardware error. No measurement possible.	Load settings (Fct. C4.6.3) (backup 1, backup 2 or factory settings). If status message still does not disappear, replace electronic unit.
F parameter	Error, operational fault of data manager, electronic unit, parameter or hardware error. Parameters no longer usable.	
F configuration	Invalid configuration: display software, bus parameter or main software do not match existing configuration.	If device configuration unchanged: defective, replace electronic unit.
F display	Error, operational fault in display. Parameter or hardware error. No measurement possible.	Defective, replace electronic unit.
F sensor electronic	Error, operational fault in sensor electronics. Parameter or hardware error. No measurement possible.	Defective, replace electronic unit.
F sensor global	Data error in the global data of the measuring sensor electronic equipment.	Load settings (Fct. C5.6.3) (backup 1, backup 2 or factory settings). If status message still does not disappear, replace electronic unit.
F sensor local	Data error in the local data of the measuring sensor electronic equipment.	Defective, replace electronic unit.
F field current local	Data error in the local data of the field current supply.	Defective, replace electronic unit.
F current output A	Error, operational fault in current output. Parameter or hardware error. No measurement possible.	Defective, replace electronic unit.
F current output C		
F software user interface	Fault revealed by CRC check of operation software.	Replace electronic unit.
F hardware settings	The set hardware parameters do not match the identified hardware. A dialogue appears in the display.	Answer queries in dialogue mode, follow directions. Defective, replace electronic unit.
F hardware detection	Existing hardware cannot be identified.	Defective, replace electronic unit.
F RAM/ROM error IO1	A RAM or ROM error is detected during the CRC check.	Defective, replace electronic unit.
F Fieldbus	Malfunction of the Fieldbus interface.	-

## Application error

Messages on the display	Description	Actions
Status: F _ _ _ _ _	<b>Application-dependent fault, device OK, but measured values affected.</b>	<b>Application test or operator action necessary.</b>
F application error	Application-dependent fault, but device is okay.	Group message, when errors as described below or other application errors occur.
F empty pipe	1 or 2 measuring electrodes are not in contact with the medium; measured value is set to zero. No measurement possible.	Measuring pipe not filled, function dependent on C1.3.2. Check installation. Or electrodes completely insulated e.g. by oil film. Clean!
F flow exceeding limit	Measuring range exceeded, filter setting limits measured values. No message if empty pipe. If this limit occurs sporadically in processes with air pockets, solid contents or low conductivity, then either the limit has to be increased or a pulse filter used so as to quell the error messages and also reduce the measurement errors.	Limitation Fct. C1.2.1, increase values.
F field frequency too high	Field frequency is not reaching steady state, a measured flow value is still being supplied but may have errors. Measured values are still supplied, but they are always too low. No message if coil broken or bridged.	If Fct. C1.1.14 settling time is on "manual", increase the value in Fct. C1.1.15. If it is set to "standard", set the field frequency in Fct. C1.1.13 according to the signal converter nameplate.
F DC offset	ADC over-ranged by DC offsets. No measurement can be performed, the flow is set to zero. No message if empty pipe.	For remote signal converters, check the connection of the signal cable.
F open circuit A	Load on current output A too high, effective current too low.	Current not correct, mA output cable has open circuit or load too high. Check cable, reduce load (set < 750 ohm).
F open circuit C		
F over range A	The current or the corresponding measured value is limited by a filter setting.	Check with Fct. C2.1 hardware or sticker in terminal compartment, which output is connected to the terminal. If current output: extend Fct. C2.x.6 range and Fct. C2.x.8 limitation. If frequency output: extend values in Fct. C2.x.5 and Fct. C2.x.7.
F over range C		
F over range D	The pulse rate or the corresponding measured value is limited by a filter setting. Or the demanded pulse rate is too high.	
F active settings	Error during the CRC check of the active settings.	Upload backup 1 or backup 2 settings, check and adjust if necessary.
F factory settings	Error during the CRC check of the factory settings.	-
F backup 1 settings	Error during the CRC check of the backup 1 or 2 settings.	Save active settings in backup 1 or 2.
F backup 2 settings		

## Measurements out of specification

Messages on the display	Description	Actions
Status: S _ _ _ _ _	<b>Out of specification, measurement continues, accuracy possibly less.</b>	<b>Maintenance required.</b>
S uncertain measurement	Device maintenance necessary; measured values only conditionally usable.	Group message, when errors as described below or other influences occur.
S empty pipe	1 or 2 measuring electrodes are not in contact with the medium; measured value is set to zero. No measurement possible.	Measuring pipe not filled, function dependent on C1.3.2. Check installation. Or electrodes completely insulated e.g. by oil film. Clean!

Messages on the display	Description	Actions
Status: S _ _ _ _ _	<b>Out of specification, measurement continues, accuracy possibly less.</b>	<b>Maintenance required.</b>
S electrode noise	Noise on the electrodes too high. Measured values are still supplied. No message if empty pipe.	a) Electrodes extremely soiled; b) Conductivity too low: activate noise or pulse filter Fct. C1.2.4, C1.2.7; c) Gas bubbles, solids or chem. reactions in medium: activate noise or pulse filter Fct. C1.2.4, C1.2.7; d) Electrode corrosion (if message also appears when flow is zero): use sensor with suitable electrode material.
S field coil broken	Field coil resistance too high.	Check field coil connections to the electronic module (for remote versions: field current cable) for open circuit / short circuit
S field coil bridged	Field coil resistance too low.	
S electronic temperature	Upper limit for the permissible electronic temperature has been exceeded.	Ambient temperature too high, direct solar radiation or, for C version, process temperature too high.
S coil temperature	Upper limit for the permissible coil temperature has been exceeded. No message if coil broken/bridged.	Process and ambient temperature too high.
S overflow counter 1	This is counter 1 or FB2 (with Profibus). Counter has overrun and started again at zero.	-
S overflow counter 2	This is counter 2 or FB3 (with Profibus). Counter has overrun and started again at zero.	-
S backplane invalid	The data record on the backplane is invalid. The CRC check has revealed a fault.	No data can be loaded from the backplane when replacing electronics. Save the data to the backplane again (Service).
S field frequency too high	The field frequency is set so high that the field current cannot settle. The measured values displayed are too low.	Set field frequency lower, see Fct. C1.1.13.

### Simulation of the measured values

Messages on the display	Description	Actions
Status: C _ _ _ _ _	<b>Output values partially simulated or fixed</b>	<b>Maintenance required.</b>
C checks in progress	Test mode of the device. Measured values are possibly simulated values or values with fixed settings.	Message depending on the situation via HART® or FDT.
C test sensor	Test function of the measuring sensor electronics is active.	-
C simulation fieldbus	Values on the Foundation Fieldbus interface are simulated.	-

### Information

Messages on the display	Description	Actions
Status: I _ _ _ _ _	<b>Information (current measurement OK)</b>	
I counter 1 stopped	This is counter 1 or FB2 (with Profibus). The counter has stopped.	If counter to continue counting, activate "yes" in Fct. C2.y.9 (start counter).
I counter 2 stopped	This is counter 2 or FB3 (with Profibus). The counter has stopped.	



Messages on the display	Description	Actions
Status: I _ _ _ _ _	Information (current measurement OK)	
I power fail	The device was not in operation for an unknown period of time, because the power was switched off. This message is for information only.	Temporary power failure. Counters did not run during it.
I over range display 1	1st line on page 1 (2) of display limited by filter setting.	Select in menu "display" Fct. C4.3 and/or C4.4 the 1st or 2nd meas. page and increase values in functions C4.z.3 range and/or C4.z.4 limitation.
I over range display 2		
I over range conductivity	The limits for the conductivity measurement have been exceeded ( $>10000 \mu\text{S}/\text{cm}$ ) or are lower than permitted ( $<0.1 \mu\text{S}/\text{cm}$ ).	If the measuring sensor has been properly connected and filled with medium, this does not affect the flow measurement. The conductivity measured values cannot be used.
I control input C act.	This message appears when the control input is active.	-
I backplane sensor	The data on the backplane are not usable because they have been generated with an incompatible version.	-
I backplane settings	The global settings on the backplane are not usable because they have been generated with an incompatible version.	-
I backplane difference	The data on the backplane differ from the data in the display. If the data are usable, a dialogue is indicated in the display.	-
I write cycles overfl.	The maximum number of write cycles of the EEPROM or FRAMS on the Profibus DP PCB has been exceeded.	-
I baudrate search	The baudrate of the Profibus DP interface is searched for.	-
I no data exchange	There is no data exchange between the signal converter and the Profibus.	-
I conductivity off	Conductivity measurement switched off.	Change the settings in Fct. C1.3.1.
I empty pipe	1 or 2 measuring electrodes are not in contact with the medium; measured value is set to zero. No measurement possible.	Measuring pipe not filled, function dependent on C1.3.2. Check installation. Or electrodes completely insulated e.g. by oil film. Clean!
I diagnosis channel off	Diagnosis value switched off.	Change the settings in Fct. C1.3.17.

## 7.1 Spare parts availability

The manufacturer adheres to the basic principle that functionally adequate spare parts for each device or each important accessory part will be kept available for a period of 3 years after delivery of the last production run for the device.

This regulation only applies to spare parts which are subject to wear and tear under normal operating conditions.

## 7.2 Availability of services

The manufacturer offers a range of services to support the customer after expiration of the warranty. These include repair, maintenance, technical support and training.



**INFORMATION!**

*For more precise information, please contact your local sales office.*

## 7.3 Returning the device to the manufacturer

### 7.3.1 General information

This device has been carefully manufactured and tested. If installed and operated in accordance with these operating instructions, it will rarely present any problems.



**CAUTION!**

*Should you nevertheless need to return a device for inspection or repair, please pay strict attention to the following points:*

- *Due to statutory regulations on environmental protection and safeguarding the health and safety of our personnel, manufacturer may only handle, test and repair returned devices that have been in contact with products without risk to personnel and environment.*
- *This means that the manufacturer can only service this device if it is accompanied by the following certificate (see next section) confirming that the device is safe to handle.*



**CAUTION!**

*If the device has been operated with toxic, caustic, flammable or water-endangering products, you are kindly requested:*

- *to check and ensure, if necessary by rinsing or neutralising, that all cavities are free from such dangerous substances,*
- *to enclose a certificate with the device confirming that is safe to handle and stating the product used.*

### 7.3.2 Form (for copying) to accompany a returned device

Company:		Address:	
Department:		Name:	
Tel. no.:		Fax no.:	
Manufacturer's order no. or serial no.:			
The device has been operated with the following medium:			
This medium is:	radioactive		
	water-hazardous		
	toxic		
	caustic		
	flammable		
	We checked that all cavities in the device are free from such substances.		
	We have flushed out and neutralized all cavities in the device.		
We hereby confirm that there is no risk to persons or the environment through any residual media contained in the device when it is returned.			
Date:		Signature:	
Stamp:			

## 7.4 Disposal



**CAUTION!**

*Disposal must be carried out in accordance with legislation applicable in your country.*

## 8.1 Measuring principle

An electrically conductive fluid flows inside an electrically insulated pipe through a magnetic field. This magnetic field is generated by a current, flowing through a pair of field coils. Inside of the fluid, a voltage  $U$  is generated:

$$U = v * k * B * D$$

in which:

$v$  = mean flow velocity

$k$  = factor correcting for geometry

$B$  = magnetic field strength

$D$  = inner diameter of flow meter

The signal voltage  $U$  is picked off by electrodes and is proportional to the mean flow velocity  $v$  and thus the flow rate  $q$ . A signal converter is used to amplify the signal voltage, filter it and convert it into signals for totalising, recording and output processing.

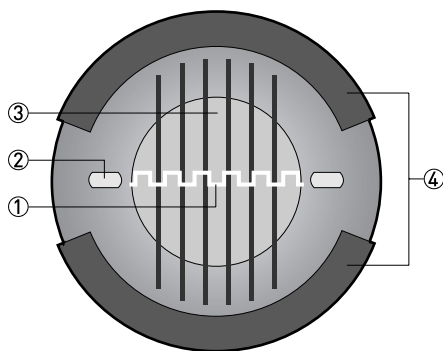


Figure 8-1: Measuring principle

- ① Induced voltage (proportional to flow velocity)
- ② Electrodes
- ③ Magnetic field
- ④ Field coils

## 8.2 Technical data



### INFORMATION!

- The following data is provided for general applications. If you require data that is more relevant to your specific application, please contact us or your local sales office.
- Additional information (certificates, special tools, software,...) and complete product documentation can be downloaded free of charge from the website (Download Center).

### Measuring system

Measuring principle	Faraday's law of induction
Application range	Continuous measurement of current volume flow, flow velocity, conductivity, mass flow (at constant density), coil temperature of the measuring sensor

### Design

Modular construction	The measuring system consists of a measuring sensor and a signal converter.
<b>Measuring sensor</b>	
OPTIFLUX 1000	DN10...150 / 3/8...6"
OPTIFLUX 2000	DN25...1200 / 1...48"
OPTIFLUX 4000	DN2.5...1200 / 1/10...48"
OPTIFLUX 5000	Flange: DN15...300 / ½...12" Sandwich: DN2.5...100 / 1/10...4"
OPTIFLUX 6000	DN2.5...150 / 1/10...6"
WATERFLUX 3000	DN25...600 / 1...24"
	With the exception of the OPTIFLUX 1000 and WATERFLUX 3000 all measuring sensors are also available in an Ex version.
<b>Signal converter</b>	
Compact version (C)	IFC 100 C (0° & 45° version)
Remote version (W)	IFC 100 W
	All signal converters are also available in an Ex version.
<b>Options</b>	
Outputs	Current output (incl. HART®), pulse output, frequency output, status output and/or limit switch
Counter	2 internal counters with a max. of 10 counter places (e.g. for counting volume and/or mass units)
Verification	Integrated verification, diagnostic functions: measuring device, empty pipe detection, stabilisation
Communication interfaces	HART® as standard
	Foundation Fieldbus, Profibus PA/DP or Modbus

<b>Display and user interface</b>	
Graphic display	LC display, backlit white.
	Size: 128 x 64 pixels, corresponds to 59 x 31 mm = 2.32" x 1.22"
	Ambient temperatures below -25°C / -13°F may affect the readability of the display.
Operating elements	4 push buttons for operator control of the signal converter without opening the housing.
Remote control	PACTware™ (including Device Type Manager (DTM))
	HART® Hand Held Communicator from Emerson Process
	AMS® from Emerson Process
	PDM® from Siemens
	All DTMs and drivers are available free of charge from the manufacturer's website.
<b>Display functions</b>	
Operating menu	Setting the parameters using 2 measuring pages, 1 status page, 1 graphic page (measured values and graphics are freely adjustable)
Language display texts (as language package)	Standard: English, French, German, Dutch, Portuguese, Swedish, Spanish, Italian
	Eastern Europe: English, Slovenian, Czech, Hungarian
	Northern Europe: English, Danish, Polish, Finnish, Norwegian
	Southern Europe: English, Turkish
	China: English, German, Chinese
Russia: English, German, Russian	
Units	Metric, British and US units selectable as required from lists for volume / mass flow and counting, flow velocity, electrical conductivity, temperature

### Measuring accuracy

Reference conditions	Medium: water
	Temperature: +20°C / +68°F
	Pressure: 1 bar / 14.5 psi
	Inlet section: ≥ 5 DN
Maximum measuring error	Standard calibration: +0.3% of the measured value +1 mm/s, depending on the measuring sensor
	Extended calibration is selectable and special calibrations are available on request.
	For detailed information and accuracy curves, refer to chapter "Accuracy".
	Current output electronics: ±10 µA; ±100 ppm/°C (typically: ±30 ppm/°C)
Repeatability	±0.1%

## Operating conditions

<b>Temperature</b>	
Process temperature	Refer to technical data for the measuring sensor.
Ambient temperature	Depending on the version and combination of outputs.
	It is a good idea to protect the converter from external heat sources such as direct sunlight as higher temperatures reduce the life cycle of all electronic components.
	Ambient temperatures below -25°C / -13°F may affect the readability of the display.
Storage temperature	-40...+70°C / -40...+158°F
<b>Pressure</b>	
Medium	Refer to technical data for the measuring sensor.
Ambient pressure	Atmospheric
<b>Chemical properties</b>	
Electrical conductivity	All media except for water: $\geq 5 \mu\text{S}/\text{cm}$ (also refer to the technical data for the measuring sensor)
	Water: $\geq 20 \mu\text{S}/\text{cm}$
State of aggregation	Conductive, liquid media
Solid content (volume)	$\leq 10\%$ for OPTIFLUX measuring sensors
Gas content (volume)	$\leq 3\%$ for OPTIFLUX measuring sensors
Flow rate	For detailed information, refer to chapter "Flow tables".
<b>Other conditions</b>	
Protection category acc. to IEC 529 / EN 60529	IP66/67 (acc. to NEMA 4/4X)

## Installation conditions

Installation	For detailed information, refer to chapter "Installation conditions".
Inlet / outlet sections	Refer to technical data for the measuring sensor.
Dimensions and weights	For detailed information refer to chapter "Dimensions and weights".

## Materials

Signal converter housing	Aluminium with a polyester topcoat
Measuring sensor	For housing materials, process connections, liners, grounding electrodes and gaskets, refer to technical data for the measuring sensor.

### Electrical connection

General	Electrical connection is carried out in conformity with the VDE 0100 directive "Regulations for electrical power installations with line voltages up to 1000 V" or equivalent national specifications.
Power supply	100...230 VAC (-15% / +10%), 50/60 Hz; non-Ex: standard; Ex: optional 240 VAC + 5% is included in the tolerance range.
	24 VDC (-55% / +30%); only available as non Ex version 12 VDC - 10% is included in the tolerance range.
	24 VAC/DC (AC: -15% / +10%; DC: -25% / +30%); non-Ex: standard; Ex: optional 12 V is <b>not</b> included in the tolerance range.
Power consumption	AC: 7 VA
	DC: 4 W
Signal cable	Only necessary for remote versions.
	<b>DS 300 (type A)</b> Max. length: 600 m / 1950 ft (dep. on electrical conductivity and measuring sensor)
Cable entries	Standard: M20 x 1.5 (8...12 mm)
	Option: ½ NPT, PF ½

### Outputs

General	All outputs are electrically isolated from each other and from all other circuits.
	All operating data and output values can be adjusted.
Description of abbreviations	$U_{ext}$ = external voltage; $R_L$ = load + resistance; $U_o$ = terminal voltage; $I_{nom}$ = nominal current



<b>Current output</b>		
Output data	Volume flow, mass flow, diagnostic value, flow velocity, coil temperature, conductivity	
Settings	<b>Without HART®</b>	
	Q = 0%: 0...20 mA; Q = 100%: 10...21.5 mA	
	Error identification: 20...22 mA	
	<b>With HART®</b>	
	Q = 0%: 4...20 mA; Q = 100%: 10...21.5 mA	
	Error identification: 3...22 mA	
<b>Operating data</b>	<b>Basic I/Os</b>	<b>Ex i I/Os</b>
Active	U <sub>int, nom</sub> = 20 VDC I ≤ 22 mA R <sub>L</sub> ≤ 750 Ω	-
	HART® at terminals A	
Passive	U <sub>ext</sub> ≤ 32 VDC I ≤ 22 mA U <sub>0</sub> ≥ 2 V at I = 22 mA R <sub>L</sub> ≤ (U <sub>ext</sub> - U <sub>0</sub> ) / I <sub>max</sub>	U <sub>ext</sub> ≤ 32 VDC I ≤ 22 mA U <sub>0</sub> ≥ 4 V R <sub>L</sub> ≤ (U <sub>ext</sub> - U <sub>0</sub> ) / I <sub>max</sub>
		U <sub>i</sub> = 30 V I <sub>i</sub> = 130 mA P <sub>i</sub> = 1 W C <sub>i</sub> = 10 nF L <sub>i</sub> ~ 0 mH
	HART® at terminals A	HART® at terminals C
<b>HART®</b>		
Description	HART® protocol via active and passive current output	
	HART® version: V5	
	Universal Common Practice HART® parameter: completely supported	
Load	≥ 250 Ω at HART® test point; Note maximum load for current output!	
Multi-drop mode	Yes, current output = 4 mA	
	Multi-drop address adjustable in operation menu 1...15	
Device drivers	Available for FC 375/475, AMS, PDM, FDT/DTM	
Registration (HART Communication Foundation)	Yes	

Pulse output / frequency output		
Output data	Pulse output: volume flow, mass flow	
	Frequency output: volume flow, mass flow, diagnostic value, flow velocity, coil temperature, conductivity	
Function	Can be set as a pulse output or frequency output	
Pulse rate/frequency	0.25...10000 Hz	
	For Modbus I/O: 0.25...1000 Hz	
Settings	Pulses per volume or mass unit or max. frequency for 100% flow	
	Pulse width: adjustable as automatic, symmetric or fixed (0.05...2000 ms)	
Operating data	Basic I/Os	Ex i I/Os
Passive	$U_{ext} \leq 32 \text{ VDC}$  $f_{max}$ in operating menu set to $f_{max} \leq 100 \text{ Hz}$ :  $I \leq 100 \text{ mA}$  open: $I \leq 0.05 \text{ mA}$ at $U_{ext} = 32 \text{ VDC}$  closed: $U_{0, max} = 0.2 \text{ V}$ at $I \leq 10 \text{ mA}$ $U_{0, max} = 2 \text{ V}$ at $I \leq 100 \text{ mA}$	-
	$f_{max}$ in operating menu set to $100 \text{ Hz} < f_{max} \leq 10 \text{ kHz}$ :  $I \leq 20 \text{ mA}$  open: $I \leq 0.05 \text{ mA}$ at $U_{ext} = 32 \text{ VDC}$  closed: $U_{0, max} = 1.5 \text{ V}$ at $I \leq 1 \text{ mA}$ $U_{0, max} = 2.5 \text{ V}$ at $I \leq 10 \text{ mA}$ $U_{0, max} = 5.0 \text{ V}$ at $I \leq 20 \text{ mA}$	-
NAMUR	-	Passive to EN 60947-5-6  open: $I_{nom} = 0.77 \text{ mA}$  closed: $I_{nom} = 4.7 \text{ mA}$  $U_i = 30 \text{ V}$ $I_i = 130 \text{ mA}$ $P_i = 1 \text{ W}$ $C_i = 10 \text{ nF}$ $L_i = 0 \text{ mH}$
Operating data	Modbus	
Passive	$U_{ext} \leq 32 \text{ VDC}$	
	$f_{max}$ in the operating menu set to $f_{max} \leq 1 \text{ kHz}$ :  $I \leq 100 \text{ mA}$  open: $I \leq 0.05 \text{ mA}$ at $U_{ext} = 32 \text{ VDC}$  closed: $U_{0, max} = 0.2 \text{ V}$ at $I \leq 10 \text{ mA}$ $U_{0, max} = 2 \text{ V}$ at $I \leq 100 \text{ mA}$	

<b>Low flow cut off</b>		
Function	Switching point and hysteresis separately adjustable for each output, counter and the display	
Switching point	Set in increments of 0.1%.	
	0...20% (current output, frequency output) or 0...±9.999 m/s (pulse output)	
Hysteresis	Set in increments of 0.1%.	
	0...5% (current output, frequency output) or 0...5 m/s (pulse output)	
<b>Time constant</b>		
Function	The time constant corresponds to the elapsed time until 67% of the end value has been reached according to a step function.	
Settings	Set in increments of 0.1s.	
	0...100 s	
<b>Status output / limit switch</b>		
Function and settings	Adjustable as automatic measuring range conversion, display of flow direction, counter overflow, error, switching point or empty pipe detection	
	Valve control with activated dosing function	
	Status and/or control: ON or OFF	
<b>Operating data</b>	<b>Basic I/Os + Modbus</b>	<b>Ex i I/Os</b>
Passive	$U_{\text{ext}} \leq 32 \text{ VDC}$  $I \leq 100 \text{ mA}$  open: $I \leq 0.05 \text{ mA}$ at $U_{\text{ext}} = 32 \text{ VDC}$  closed: $U_{0, \text{max}} = 0.2 \text{ V}$ at $I \leq 10 \text{ mA}$ $U_{0, \text{max}} = 2 \text{ V}$ at $I \leq 100 \text{ mA}$	-
	NAMUR	-

<b>Control input</b>		
Function	Hold value of the outputs (e.g. for cleaning work), set value of the outputs to "zero", counter and error reset, range change.	
	Start of dosing when dosing function is activated.	
<b>Operating data</b>	<b>Basic I/Os</b>	<b>Ex i I/Os + Modbus</b>
Passive	$U_{ext} \leq 32 \text{ VDC}$ $I_{nom} = 6.5 \text{ mA}$ at $U_{ext} = 24 \text{ VDC}$ $I_{nom} = 8.2 \text{ mA}$ at $U_{ext} = 32 \text{ VDC}$  Contact closed (on): $U_0 \geq 8 \text{ V}$ with $I_{nom} = 2.8 \text{ mA}$  Contact open (off): $U_0 \leq 2.5 \text{ V}$ with $I_{nom} = 0.4 \text{ mA}$	-
<b>PROFIBUS DP</b>		
Description	Galvanically isolated acc. to IEC 61158-2	
	PA profile version: class B, V3.02	
	Automatic data transmission rate recognition (max. 1.5 MBaud)	
	Bus address adjustable via local display at the measuring device	
Function blocks	5 x analogue input, 3 x totaliser	
Output data	Volume flow, mass flow, volume counter 1 + 2, mass counter, velocity, coil temperature, conductivity	
<b>PROFIBUS PA</b>		
Description	Galvanically isolated acc. to IEC 61158-2	
	PA profile version: class B, V3.02	
	Current consumption: 10.5 mA	
	Permissible bus voltage: 9...32 VDC; in Ex application: 9...24 VDC	
	Bus interface with integrated reverse polarity protection	
	Typical error current FDE (Fault Disconnection Electronic): 6 mA	
	Bus address adjustable via local display at the measuring device	
Function blocks	5 x analogue input, 3 x totaliser	
Output data	Volume flow, mass flow, volume counter 1 + 2, mass counter, velocity, coil temperature, conductivity	
<b>FOUNDATION Fieldbus</b>		
Description	Galvanically isolated acc. to IEC 61158-2	
	Current consumption: 10.5 mA	
	Permissible bus voltage: 9...32 VDC; in Ex application: 9...24 VDC	
	Bus interface with integrated reverse polarity protection	
	Link Master function (LM) supported	
	Tested with Interoperable Test Kit (ITK) version 5.2	
Function blocks	3 x analogue input, 2 x integrator, 1 x PID	
Output data	Volume flow, mass flow, velocity, coil temperature, conductivity, electronics temperature	

<b>Modbus</b>	
Description	Modbus RTU, Master / Slave, RS485
Address range	1...247
Broadcast	Supported with function code 16
Supported Baudrate	1200, 2400, 3600, 4800, 9600, 19200, 38400, 57600, 115200 Baud

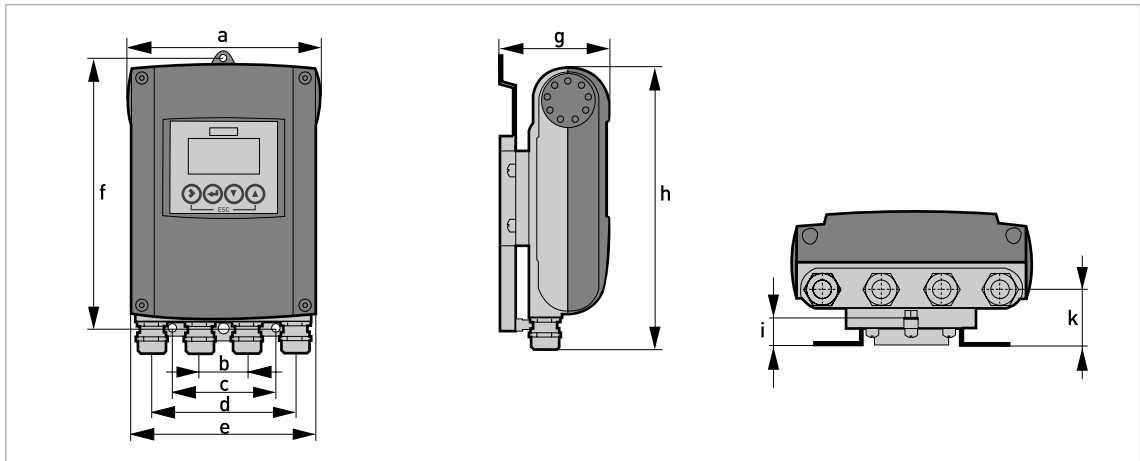
### Approvals and certificates

CE	The device fulfils the statutory requirements of the EC directives. The manufacturer certifies that these requirements have been met by applying the CE marking.
Non-Ex	Standard
<b>Hazardous areas</b>	
ATEX	<b>Optional (only OPTIFLUX 2100 C and OPTIFLUX 4100 C)</b>
	II 2 G Ex e [ia] mb IIC T4 (DN10...20; DN200...300; DN350...3000)
	II 2 G Ex d e [ia] mb IIC T4 (DN25...150)
	II 2 G Ex e [ia] mb q T4/T3 (DN25...150; DN200...300)
	II 2 D Ex tD A21 IP64 T120°C (all nominal sizes)
	<b>Option (W version only)</b>
	II 2 D Ex tD A21 IP64 T135°C
IECEX	<b>Optional (only OPTIFLUX 2100 C and OPTIFLUX 4100 C)</b>
	Ex e [ia] mb IIC T4 (DN10...20; DN200...300; DN350...3000)
	Ex d e [ia] mb IIC T4 (DN25...150)
	Ex tD A21 IP64 T120°C (all nominal sizes)
	<b>Option (W version only)</b>
	Ex e [ia] mb IIC T4
	Ex tD A21 IP64 T135°C
FM/CSA	<b>Optional (only OPTIFLUX 2100 C and OPTIFLUX 4100 C)</b>
	Class I, Div 2, Group A, B, C and D
	<b>Option (W version only)</b>
	Class I, Div 2, Group A, B, C and D
<b>Other standards and approvals</b>	
FM/CSA	Ordinary location
Shock and vibration resistance	IEC 68-2-27, IEC 68-2-64
Electromagnetic compatibility (EMC)	2004/108/EC in conjunction with EN 61326-1 (A1, A2)
European Pressure Equipment Directive	PED 97/23 (only for compact versions)
NAMUR	NE 21, NE 43, NE 53

### 8.3 Dimensions and weights

#### 8.3.1 Housing

Wall-mounted version



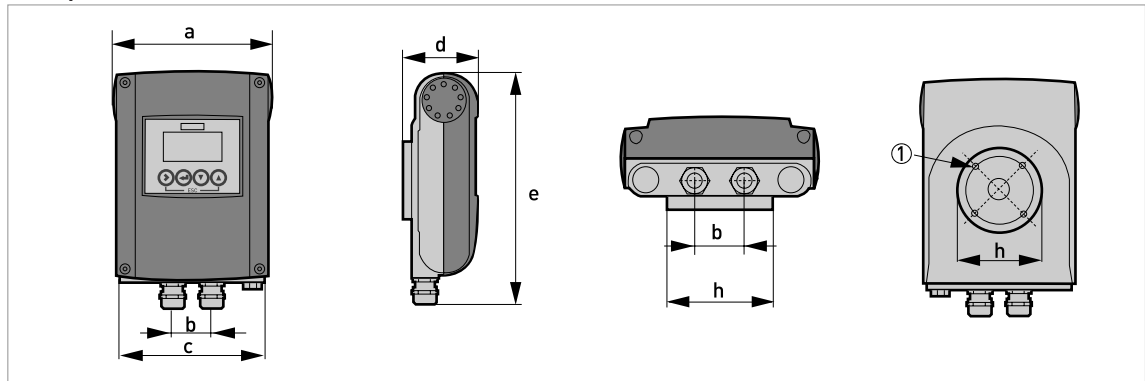
Dimensions and weights in mm and kg

	Dimensions [mm]										Weight [kg]
	a	b	c	d	e	f	g	h	i	k	
Wall-mounted version	161	40	87.2	120	155	241	95.2	257	19.3	39.7	Std: 1.9 Ex: 2.4

Dimensions and weights in inch and lb

	Dimensions [inch]										Weight [lb]
	a	b	c	d	e	f	g	h	i	k	
Wall-mounted version	6.34	1.57	3.43	4.72	6.10	9.50	3.75	10.12	0.76	1.56	Std: 4.2 Ex: 5.3

## Compact 0° version



① 4 x M 6

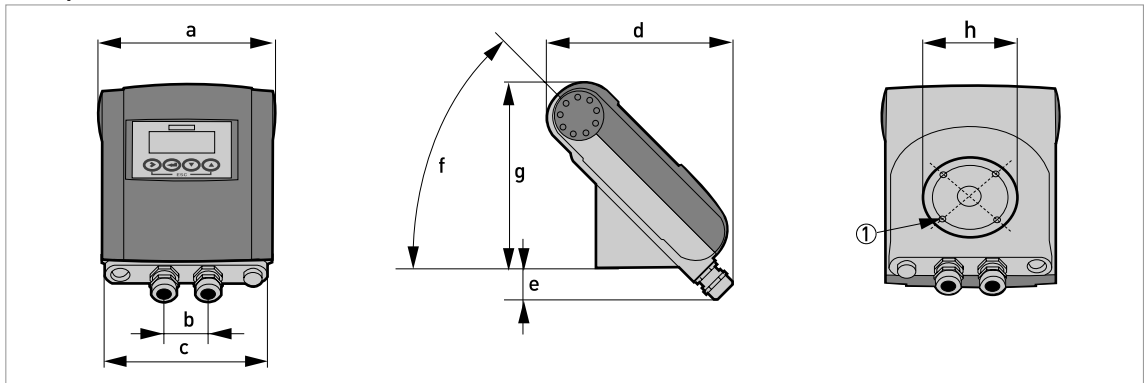
## Dimensions and weights in mm and kg

	Dimensions [mm]								Weight [kg]
	a	b	c	d	e	f	g	h	
0° version	161	40	155	81.5	257	-	-	Ø72	Std: 1.9 Ex: 2.4

## Dimensions and weights in inch and lb

	Dimensions [inch]								Weight [lb]
	a	b	c	d	e	f	g	h	
0° version	6.34	1.57	6.1	3.21	10.12	-	-	Ø2.83	Std: 4.2 Ex: 5.3

Compact 45° version



① 4 x M 6

Dimensions and weights in mm and kg

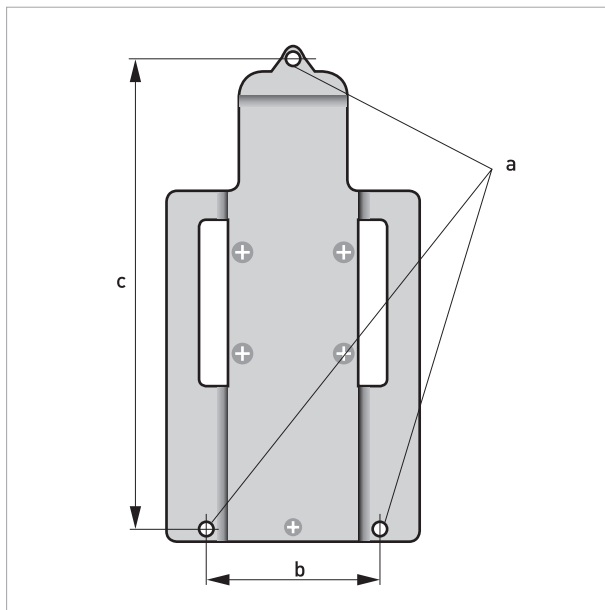
	Dimensions [mm]								Weight [kg]
	a	b	c	d	e	f	g	h	
45° version	161	40	155	184	27.4	45°	186	Ø72	Std: 2.1 Ex: 2.6

Dimensions and weights in inch and lb

	Dimensions [inch]								Weight [lb]
	a	b	c	d	e	f	g	h	
45° version	6.34	1.57	6.10	7.24	1.08	45°	7.32	Ø2.83	Std: 4.6 Ex: 5.7



### 8.3.2 Mounting plate, wall-mounted version



Dimensions in mm and inch

	[mm]	[inch]
a	Ø6.5	Ø0.26
b	87.2	3.4
c	241	9.5

## 8.4 Flow tables

Flow rate in m/s and m<sup>3</sup>/h

	Q <sub>100%</sub> in m <sup>3</sup> /h			
v [m/s]	0.3	1	3	12
DN [mm]	Min. flow	Nominal flow		Max. flow
2.5	0.005	0.02	0.05	0.21
4	0.01	0.05	0.14	0.54
6	0.03	0.10	0.31	1.22
10	0.08	0.28	0.85	3.39
15	0.19	0.64	1.91	7.63
20	0.34	1.13	3.39	13.57
25	0.53	1.77	5.30	21.21
32	0.87	2.90	8.69	34.74
40	1.36	4.52	13.57	54.29
50	2.12	7.07	21.21	84.82
65	3.58	11.95	35.84	143.35
80	5.43	18.10	54.29	217.15
100	8.48	28.27	84.82	339.29
125	13.25	44.18	132.54	530.15
150	19.09	63.62	190.85	763.40
200	33.93	113.10	339.30	1357.20
250	53.01	176.71	530.13	2120.52
300	76.34	254.47	763.41	3053.64
350	103.91	346.36	1039.08	4156.32
400	135.72	452.39	1357.17	5428.68
450	171.77	572.51	1717.65	6870.60
500	212.06	706.86	2120.58	8482.32
600	305.37	1017.90	3053.70	12214.80
700	415.62	1385.40	4156.20	16624.80
800	542.88	1809.60	5428.80	21715.20
900	687.06	2290.20	6870.60	27482.40
1000	848.22	2827.40	8482.20	33928.80
1200	1221.45	3421.20	12214.50	48858.00

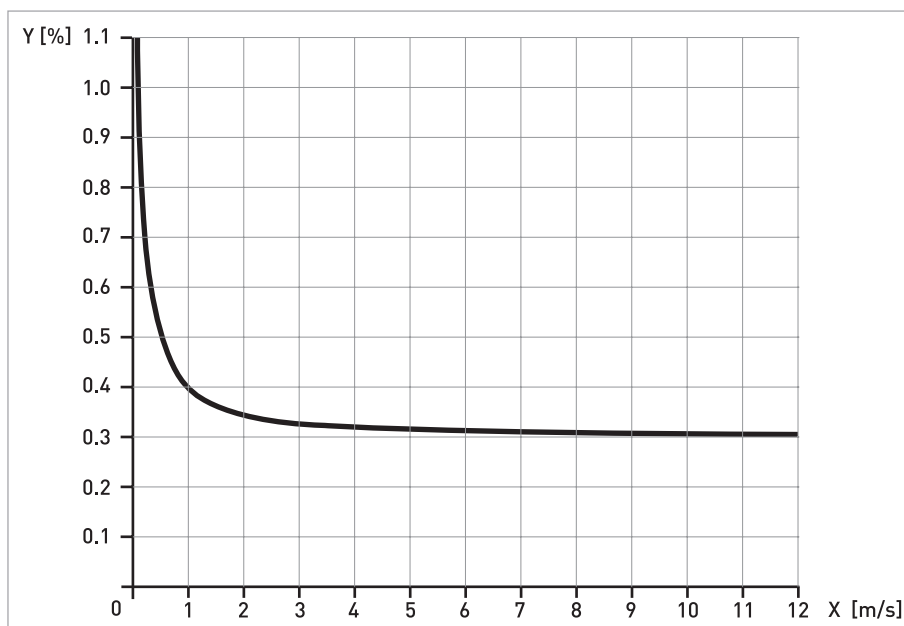
## Flow rate in ft/s and US gallons/min

v [ft/s]	Q <sub>100</sub> % in US gallons/min			
	1	3.3	10	40
DN [inch]	Min. flow	Nominal flow		Max. flow
1/10	0.02	0.09	0.23	0.93
1/8	0.06	0.22	0.60	2.39
1/4	0.13	0.44	1.34	5.38
3/8	0.37	1.23	3.73	14.94
1/2	0.84	2.82	8.40	33.61
3/4	1.49	4.98	14.94	59.76
1	2.33	7.79	23.34	93.36
1.25	3.82	12.77	38.24	152.97
1.5	5.98	19.90	59.75	239.02
2	9.34	31.13	93.37	373.47
2.5	15.78	52.61	159.79	631.16
3	23.90	79.69	239.02	956.09
4	37.35	124.47	373.46	1493.84
5	58.35	194.48	583.24	2334.17
6	84.03	279.97	840.29	3361.17
8	149.39	497.92	1493.29	5975.57
10	233.41	777.96	2334.09	9336.37
12	336.12	1120.29	3361.19	13444.77
14	457.59	1525.15	4574.93	18299.73
16	597.54	1991.60	5975.44	23901.76
18	756.26	2520.61	7562.58	30250.34
20	933.86	3112.56	9336.63	37346.53
24	1344.50	4481.22	13445.04	53780.15
28	1829.92	6099.12	18299.20	73196.79
32	2390.23	7966.64	23902.29	95609.15
36	3025.03	10082.42	30250.34	121001.37
40	3734.50	12447.09	37346.00	149384.01
48	5377.88	17924.47	53778.83	215115.30

## 8.5 Measuring accuracy

### Reference conditions

- Medium: water
- Temperature: +20°C / +68°F
- Pressure: 1 bar / 14.5 psi
- Inlet section:  $\geq 5$  DN



X [m/s]: flow velocity

Y [%]: deviation from the actual measured value (mv)

Standard calibration	DN [mm]	DN [inch]	Accuracy	Curve
OPTIFLUX 2100 / 4100 / 5100 / 6100	10...1200	3/8...48	0.3% of mv + 1 mm/s	①
OPTIFLUX 1100	10...150	3/8...6	0.4% of mv + 1 mm/s	as ① + 0.1%
OPTIFLUX 4100 / 5100 / 6100	2.5...6	1/10...1/4		
WATERFLUX 3100	25...600	1...24	0.3% of mv + 1 mm/s	①

Extended calibration	DN [mm]	DN [inch]	Accuracy	Curve
OPTIFLUX 2100 / 4100 / 5100 / 6100	10...1200	3/8...48	0.2% of mv + 1 mm/s	as ① - 0.1%

## 9.1 General description

The open HART<sup>®</sup> protocol, which can be used freely, is integrated into the signal converter for communication.

Devices which support the HART<sup>®</sup> protocol are classified as either operating devices or field devices. When it comes to operating devices (Master), both manual control units (Secondary Master) and PC-supported workstations (Primary Master) are used in, for example, a control centre.

HART<sup>®</sup> field devices include measuring sensors, signal converters and actuators. The field devices range from 2-wire to 4-wire to intrinsically safe versions for use in hazardous areas.

The HART<sup>®</sup> data are superimposed over the analogue 4...20 mA signal via FSK modem. This way, all of the connected devices can communicate digitally with one another via the HART<sup>®</sup> protocol while simultaneously transmitting the analogue signals.

When it comes to the field devices and secondary masters, the FSK or HART<sup>®</sup> modem is integrated, whereas with a PC communication takes place via an external modem which must be connected to the serial interface. There are, however, other connection variants which can be seen in the following connection figures.

## 9.2 Software history



### **INFORMATION!**

*In the table below, "x" is a placeholder for possible multi-digit alphanumeric combinations, depending on the available version.*

Release date	Electronic Revision	SW.REV.UIS	SW.REV.MS	HART <sup>®</sup>	
				Device Revision	DD Revision
2008-02-29	2.0.x	2.0.x	2.0.x	2	1
2010-01-04	2.1.x	2.1.x	3.0.x	3	1
2011-12-12	3.0.x	3.0.x	4.0.x	3	1
2014-08-01	3.1.x	3.1.x	4.0.x	4	1

### HART<sup>®</sup> identification codes and revision numbers

Manufacturer ID:	69 (0x45)
Device:	217 (0xD9)
HART <sup>®</sup> Universal Revision:	5
FC 375/475 system SW.Rev.:	≥ 1.8
AMS version:	≥ 7.0
PDM version:	≥ 6.0
FDT version:	≥ 1.2

### 9.3 Connection variants

The signal converter is a 4-wire device with 4...20 mA current output and HART<sup>®</sup> interface. Depending on the version, the settings and the wiring, the current output can operate as passive or active output.

- **Multi-Drop Mode is supported**  
In a Multi-Drop communication system, more than 2 devices are connected to a common transmission cable.
- **Burst Mode is not supported**  
In the Burst Mode a slave device transfers cyclic pre-defined response telegrams, to get a higher rate of data transfer.



**INFORMATION!**

*For detailed information about the electrical connection of the signal converter for HART<sup>®</sup>, refer to the section "Electrical connection".*

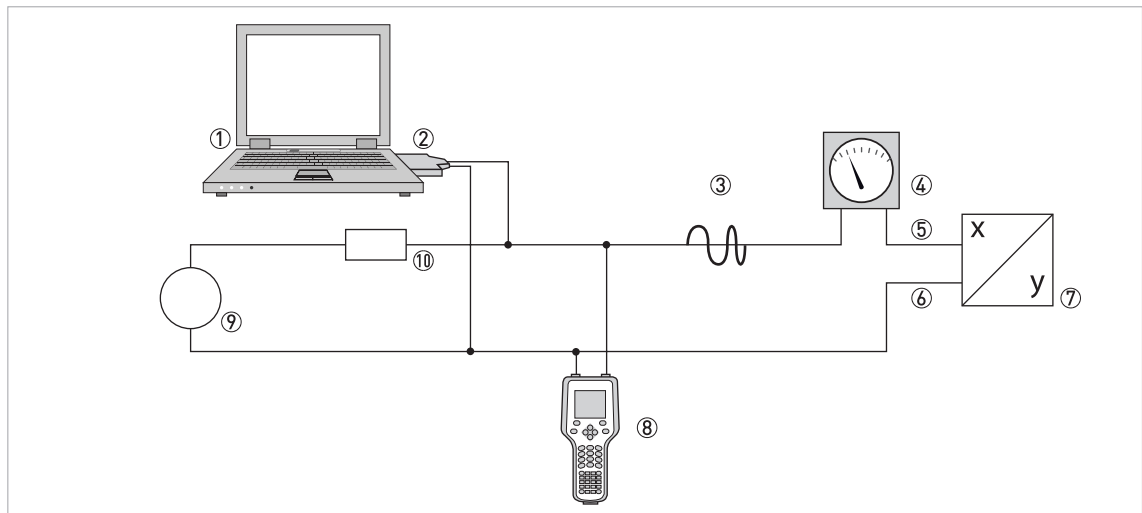
There are two ways of using the HART<sup>®</sup> communication:

- as Point-to-Point connection and
- as multi-drop connection, with 2-wire connection or as multi-drop connection, with 3-wire connection.

### 9.3.1 Point-to-Point connection - analogue / digital mode

Point-to-Point connection between the signal converter and the HART® Master.

The current output of the device may be active or passive.

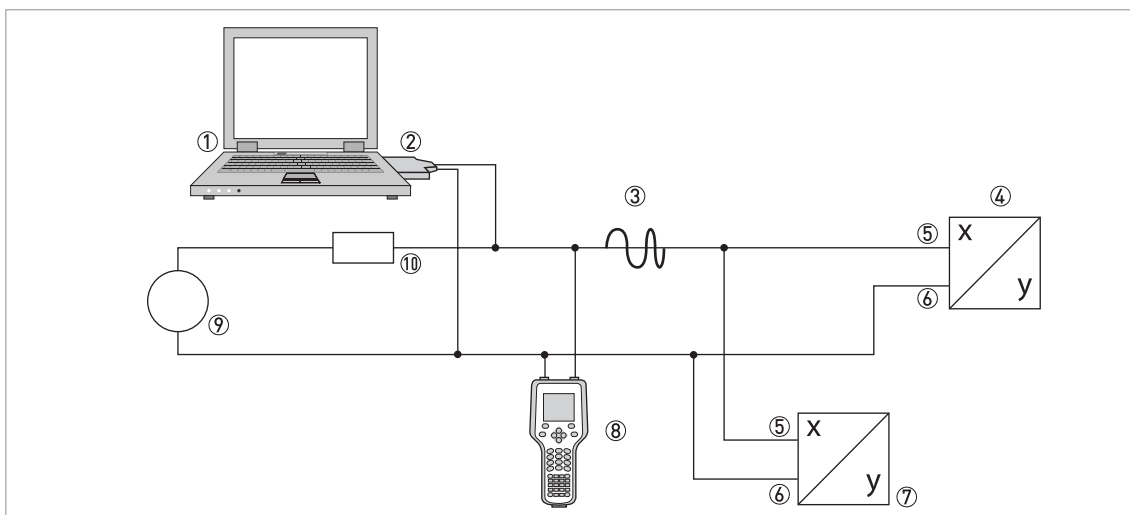


- ① Primary master
- ② FSK modem or HART® modem
- ③ HART® signal
- ④ Analog indication
- ⑤ Signal converter terminals A (C)
- ⑥ Signal converter terminals A- (C-)
- ⑦ Signal converter with address = 0 and passive or active current output
- ⑧ Secondary Master
- ⑨ Power supply for devices (slaves) with passive current output
- ⑩ Load  $\geq 250 \Omega$  (0hm)

### 9.3.2 Multi-Drop connection (2-wire connection)

In the case of a multi-drop connection, up to 15 devices may be installed in parallel (this signal converter and other HART<sup>®</sup> devices).

The current outputs of the devices must be passive!

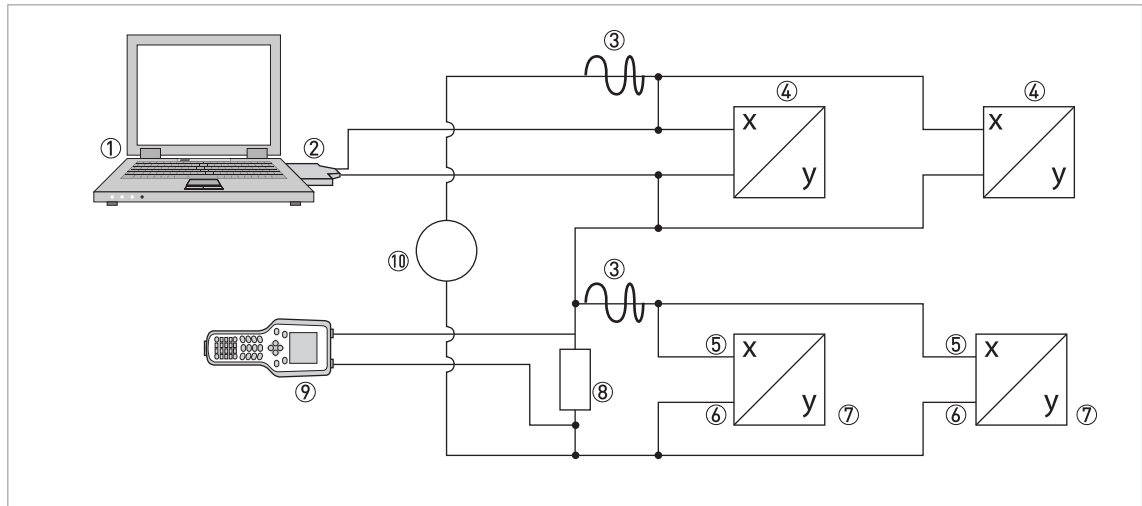


- ① Primary Master
- ② HART<sup>®</sup> modem
- ③ HART<sup>®</sup> signal
- ④ Other HART<sup>®</sup> devices or this signal converter (see also ⑦)
- ⑤ Signal converter terminals A (C)
- ⑥ Signal converter terminals A- (C-)
- ⑦ Signal converter with address > 0 and passive current output, connection of max. 15 devices (slaves) with 4...20 mA
- ⑧ Secondary Master
- ⑨ Power supply
- ⑩ Load  $\geq 250 \Omega$  (Ohm)



### 9.3.3 Multi-Drop connection (3-wire connection)

Connection of 2-wire and 4-wire devices in the same network. In order that the current output of the signal converter is working continuously active, an additional third wire must be connected to the devices in the same network. These devices must be powered via a 2-wire loop.



- ① Primary Master
- ② HART<sup>®</sup> modem
- ③ HART<sup>®</sup> signal
- ④ 2-wire external devices (slaves) with 4...20 mA, addresses > 0, powered by current loop
- ⑤ Signal converter terminals A (C)
- ⑥ Signal converter terminals A- (C-)
- ⑦ Connection of active or passive 4-wire devices (slaves) with 4...20 mA, addresses > 0
- ⑧ Load  $\geq 250 \Omega$  (Ohm)
- ⑨ Secondary Master
- ⑩ Power supply

## 9.4 Outputs and HART<sup>®</sup> dynamic variables and device variables

The signal converter is available with various output combinations.

The connection of the terminals A and D to the HART<sup>®</sup> dynamic variables PV, SV, TV and 4V depends on the device version.

PV = Primary Variable; SV = Secondary Variable; TV = Third Variable; 4V = Fourth Variable

Signal converter version	HART <sup>®</sup> dynamic variable			
	PV	SV	TV	4V
Basic I/O, connection terminals	A	D	-	-

The signal converter can provide up to 8 measurement-related values. The measured values are accessible as so-called HART<sup>®</sup> device variables and can be connected to the HART<sup>®</sup> dynamic variables. The availability of these variables depends on the device versions and the settings.

Code = device variable code

### Device variables

HART <sup>®</sup> device variable	Code	Type	Explanations
flow speed	20	linear	-
volume flow	21	linear	
mass flow	22	linear	
conductivity	24	linear	
coil temperature	23	linear	
counter 1	6	Counter	-
counter 2	14	Counter	
diagnosis value	25	linear	Function and availability depends on diagnosis value setting.
operating hours	1	Counter	-

For the dynamic variables connected to the linear analogue outputs for current and/or frequency, the assignment of the device variables takes place by selecting the linear measurement for these outputs under the appropriate function of the signal converter. It follows that the dynamic variables connected to current or frequency outputs can only be assigned to the linear HART<sup>®</sup> device variables.

The HART<sup>®</sup> dynamic variable PV is always connected to the HART<sup>®</sup> current output which is, for example, assigned to the volume flow.

A totaliser device variable can thus not be assigned to the dynamic variable PV because the PV is always connected to the HART<sup>®</sup> current output.

Such correlations do not exist for dynamic variables not connected to linear analogue outputs. Both linear and totaliser device variables can be assigned.

The totaliser device variables can only be assigned to the dynamic variables SV, TV and 4V if the connected output is not a current or frequency output.

## 9.5 Parameter for the basic configuration

There are parameters, such as counter 1 or 2, and a selection of the diagnosis values, that require a warm start for the device following data changes in order to update dependent unit parameters, for example, before other parameters are written.

Depending on the characteristic of the HART<sup>®</sup> host system, e.g. online/offline mode, these parameters are treated differently. See the following section for more detailed information.

## 9.6 Field Communicator 375/475 (FC 375/475)

The Field Communicator is a hand terminal from Emerson Process Management that is designed to configure HART® and Foundation Fieldbus devices. Device Descriptions (DDs) are used to integrate different devices into the Field Communicator.

### 9.6.1 Installation

The HART® Device Description for the signal converter must be installed on the Field Communicator. Otherwise only the functions of a generic DD are available to the user and the entire device control is not possible. A "Field Communicator Easy Upgrade Programming Utility" is required to install the DDs on the Field Communicator.

The Field Communicator must be equipped with a system card with "Easy Upgrade Option". For details consult the Field Communicator User's Manual.

### 9.6.2 Operation



**INFORMATION!**

*For more detailed information see Appendix A, Menu tree for Basic DD.*

Operating the signal converter via the Field Communicator is very similar to manual device control using the keyboard.

Limitation: The service menu parameters for the device are not supported and a simulation is only possible for current outputs. The online help for each parameter contains its function number as a reference to the local device display.

Parameter protection for custody transfer is the same as on the device's local display. Other specific protective functions such as the passwords for the quick setup menu and the setup menu are not supported with HART®.

The Field Communicator always saves a complete configuration for the exchange with AMS, see Appendix A. However, in the offline configuration and when sending to the device, the Field Communicator only takes into account a partial parameter set (like the standard configuration of the old HART® Communicator 275).

### 9.6.3 Parameter for the basic configuration

In online mode, counter measurements and the diagnosis value can be set using special methods, see Appendix A. In offline mode, these parameters are read-only. However, when transferring the offline configuration, this data is also written to the device.

## 9.7 Asset Management Solutions (AMS)

The Asset Management Solutions Device Manager (AMS) is a PC program from Emerson Process Management which is designed to configure and manage HART<sup>®</sup>, PROFIBUS and Foundation-Fieldbus devices. Device Descriptions (DDs) are used to integrate different devices into the AMS.

### 9.7.1 Installation

If the signal converter Device Description has not yet been installed on the AMS system, a so-called Installation Kit HART<sup>®</sup> AMS is required. It is available for download from the website or on CD ROM.

For installation with the Installation Kit refer to the "AMS Intelligent Device Manager Books Online" section "Basic Functionality / Device Information / Installing Device Types".



**INFORMATION!**

*Please read the "readme.txt", which is also contained in the Installation Kit.*

### 9.7.2 Operation



**INFORMATION!**

*For more detailed information see Appendix B, Menu tree for AMS.*

Due to AMS requirements and conventions, there are differences when operating the signal converter with AMS and operating using the local keyboard. The service menu parameters are not supported and simulation is only possible for current outputs. The online help for each parameter contains its function number as a reference to the local device display.

Parameter protection for custody transfer is the same as on the device's local display. Other specific protective functions such as the passwords for the "quick setup" menu and the "setup" menu are not supported with HART<sup>®</sup>.

### 9.7.3 Parameter for the basic configuration

In online mode, the measurements for counters and diagnosis values can be changed by using the appropriate methods in the basic configuration menu. These parameters are read-only in offline mode.

## 9.8 Field Device Manager (FDM)

A Field Device Manager (FDM) is basically a PC program from Honeywell used to configure HART<sup>®</sup>, PROFIBUS and Foundation Fieldbus devices. Device Descriptions (DDs) are used to integrate different devices into the FDM.

### 9.8.1 Installation

If the signal converter Device Description has not yet been installed on the FDM system, the Device Description is required in binary format and is available for download from the website or on CD ROM.

See the section regarding Managing DDs in the FDM User Guide for information on installing the Device Descriptions in binary format.

### 9.8.2 Operation



**INFORMATION!**

*For more detailed information see Appendix A, Menu tree for Basic DD.*

Operating the signal converter via the Field Device Manager is very similar to manual device control using the keyboard.

Limitation: The Service Menu parameters for the device are not supported and a simulation is only possible for current outputs. The online help for each parameter contains its function number as a reference to the local device display.

Parameter protection for custody transfer is the same as on the device's local display. Other specific protective functions such as the passwords for the quick setup menu and the setup menu are not supported with HART<sup>®</sup>.

## 9.9 Process Device Manager (PDM)

The Process Device Manager (PDM) is a Siemens PC program designed to configure HART<sup>®</sup> and PROFIBUS devices. Device Descriptions (DDs) are used to integrate different devices into the PDM.

### 9.9.1 Installation

If the signal converter Device Description has not yet been installed on the PDM system, a so-called Device Install HART<sup>®</sup> PDM is required for the signal converter. This is available for download from the website or on CD-ROM.

For installation under PDM V 5.2, see PDM manual, section 11.1 - Install device / Integrate device into SIMATIC PDM with Device Install.

For installation under PDM V 6.0, see PDM manual, Section 13 - Integrating devices.

Please also read the "readme.txt", which is also contained in the Installation Kit.

### 9.9.2 Operation

**INFORMATION!**

*For more detailed information see Appendix C, Menu tree for PDM.*

Due to PDM requirements and conventions, there are differences when operating the signal converter with PDM and operating using the local keyboard. The service menu parameters are not supported and simulation is only possible for current outputs. The online help for each parameter contains its function number as a reference to the local device display.

Parameter protection for custody transfer is the same as on the device's local display. Other specific protective functions such as the passwords for the "quick setup" menu and the "setup" menu are not supported with HART®.

### 9.9.3 Parameter for the basic configuration

The counter measurements and the diagnosis values can be set directly in the PDM offline table. The dependent unit parameters are automatically updated. However, automatic updating is not possible in online dialogues of the PDM parameter table.

## 9.10 Field Device Tool / Device Type Manager (FDT / DTM)

A Field Device Tool Container (FDT Container) is basically a PC program used to configure HART<sup>®</sup>, PROFIBUS and Foundation Fieldbus devices. To adapt to different devices, an FDT container uses a so-called Device Type Manager (DTM).

### 9.10.1 Installation

If the Device Type Manager for the signal converter has not yet been installed on the Field Device Tool Container, setup is required and is available for download from the website or on CD-ROM. See the supplied documentation for information on how to install and set up the DTM.

### 9.10.2 Operation

Operating the signal converter via DTM is very similar to manual device control using the keyboard. See also local device display.

## 9.11 Appendix A: HART<sup>®</sup> menu tree for Basic-DD



### **INFORMATION!**

*The numbering in the following table may change depending on the version of the signal converter!*

### **Abbreviations of the following tables:**

- <sup>Opt</sup> Optional, depending on device version and configuration
- <sup>Rd</sup> Read only
- <sup>Cust</sup> Custody lock protection
- <sup>Loc</sup> Local, affects only DD host views



## 9.11.1 Overview Basic-DD menu tree (positions in menu tree)

1 dynam. variable	1 measured values	
	2 IO (Inputs/Outputs)	
2 quick setup	1 language	
	2 tag	
	3 reset	
	4 analogue outputs	
	5 digital outputs	
3 test	1 simulation	
	2 information	
4 setup	1 process input	1 calibration
		2 filter
		3 self test
		4 information
		5 sensor limits
	2 I/O	1 hardware
		2 (terminals) A
		3 (terminals) C
		4 (terminals) D
	3 I/O counter	1 counter 1
		2 counter 2
	4 I/O HART	1 PV is <sup>Rd</sup>
		2 SV is
		3 TV is
		4 4V is
		5 D/A trim
		6 apply values
		7 HART units
	5 device	1 device info
		2 display
		3 1. meas. page
		4 2. meas. page
		5 graphic page
		6 special functions
		7 units (device)
		8 HART

## 9.11.2 Basic-DD menu tree (details for settings)

## 1 dynam. variable

1 measurements	1 volume flow / 2 mass flow / 3 flow speed / 4 conductivity / 5 coil temperature / 6 counter 1 <sup>Opt</sup> / 7 counter 2 <sup>Opt</sup> / 8 diagnosis value <sup>Opt</sup>
2 IO (Inputs/Outputs)	1 A <sup>Opt</sup> / 2 % range A <sup>Opt</sup> / 3 D <sup>Opt</sup> / 4 % range D <sup>Opt</sup>

## 2 quick setup

1 language	-
2 tag	-
3 reset	1 reset errors / 2 reset counter 1 <sup>Cust</sup> / 3 reset counter 2 <sup>Cust</sup>
4 analogue outputs	1 measurement A <sup>Cust</sup> / 2 unit <sup>Cust</sup> / 3 range min A <sup>Cust</sup> / 4 range max A <sup>Cust</sup> / 5 lfc threshold <sup>Cust</sup> / 6 lfc hysteresis <sup>Cust</sup> / 7 time constant <sup>Cust</sup>
5 digital outputs	1 measurement D <sup>Opt, Cust</sup> / 2 pulse value unit <sup>Opt, Cust</sup> / 3 value p. pulse D <sup>Opt, Cust</sup> / 4 lfc threshold <sup>Opt, Cust</sup> / 5 lfc hysteresis <sup>Opt, Cust</sup>

## 3 test

1 simulation	1 simul. current A <sup>Opt</sup> / 2 simul. frequency D <sup>Opt</sup>
2 information	1 C number / 2 info process input / 3 SW.REV.MS / 4 SW.REV.UIS

## 4 setup

1 process input	1 calibration	1 autom. zero calib. <sup>Cust</sup> / 2 zero calibration <sup>Cust</sup> / 3 size <sup>Cust</sup> / 4 GKL <sup>Opt, Cust</sup> / 5 coil resistance Rsp <sup>Cust</sup> / 6 density <sup>Cust</sup> / 7 target conduct. <sup>Cust</sup> / 8 EF electr. factor <sup>Cust</sup> / 9 field frequency <sup>Cust</sup> / 10 select settling <sup>Cust</sup> / 11 settling time <sup>Opt Cust</sup> / 12 line frequency <sup>Cust</sup>
	2 filter	1 limitation min <sup>Cust</sup> / 2 limitation max <sup>Cust</sup> / 3 flow direction <sup>Cust</sup> / 4 time constant / 5 pulse filter <sup>Cust</sup> / 6 pulse width <sup>Opt, Cust</sup> / 7 pulse limitation <sup>Opt, Cust</sup> / 8 noise filter <sup>Cust</sup> / 9 noise level <sup>Opt, Cust</sup> / 10 noise suppression <sup>Opt, Cust</sup> / 11 lfc threshold <sup>Cust</sup> / 12 lfc hysteresis <sup>Cust</sup>
	3 self test	1 empty pipe <sup>Cust</sup> / 2 limit empty pipe <sup>Opt, Cust</sup> / 3 electrode noise <sup>Cust</sup> / 4 limit electr. noise <sup>Opt, Cust</sup> / 5 settling of field <sup>Cust</sup> / 6 diagnosis value <sup>Rd</sup> / 7 select diagnosis

	4 information	1 liner / 2 electr. material / 3 serial no. sensor <sup>Rd</sup> / 4 V no. sensor <sup>Rd</sup> / 5 sensor electr. info
	5 sensor limits	1 volume flow
		2 mass flow
		3 flow speed
		4 conductivity
5 coil temperature	1 upper snsr limit <sup>Rd</sup> / 2 lower snsr limit <sup>Rd</sup> / 3 minimum span <sup>Rd</sup>	
2 I/O	1 hardware	1 terminals A <sup>Cust</sup> / 2 terminals C <sup>Cust</sup> / 3 terminals D <sup>Cust</sup>
	2 A	<b>Current Output<sup>Opt.</sup>:</b> 1 range 0% <sup>Cust</sup> / 2 range 100% <sup>Cust</sup> / 3 extended range min <sup>Cust</sup> / 4 extended range max <sup>Cust</sup> / 5 error current <sup>Cust</sup> / 6 error condition <sup>Cust</sup> / 7 measurement <sup>Cust</sup> / 8 range min <sup>Cust</sup> / 9 range max <sup>Cust</sup> / 10 polarity <sup>Cust</sup> / 11 limitation min <sup>Cust</sup> / 12 limitation max <sup>Cust</sup> / 13 lfc threshold <sup>Cust</sup> / 14 lfc hysteresis <sup>Cust</sup> / 15 time constant <sup>Cust</sup> / 16 special function <sup>Cust</sup> / 17 rc threshold <sup>Opt, Cust</sup> / 18 rc hysteresis <sup>Opt, Cust</sup> / 19 information  <b>frequency output<sup>Opt.</sup>:</b> 1 pulse shape <sup>Cust</sup> / 2 pulse width <sup>Cust</sup> / 3 100% pulse rate <sup>Cust</sup> / 4 measurement <sup>Cust</sup> / 5 range min <sup>Cust</sup> / 6 range max <sup>Cust</sup> / 7 polarity <sup>Cust</sup> / 8 limitation min <sup>Cust</sup> / 9 limitation max <sup>Cust</sup> / 10 lfc threshold <sup>Cust</sup> / 11 lfc hysteresis <sup>Cust</sup> / 12 time constant <sup>Cust</sup> / 13 invert signal <sup>Cust</sup> / 14 special function <sup>Opt, Cust</sup> / 15 information  <b>pulse output<sup>Opt.</sup>:</b> 1 pulse shape <sup>Cust</sup> / 2 pulse width <sup>Cust</sup> / 3 max. pulse rate <sup>Cust</sup> / 4 measurement <sup>Cust</sup> / 5 pulse value unit / 6 value p. pulse / 7 polarity <sup>Cust</sup> / 8 lfc threshold <sup>Cust</sup> / 9 lfc hysteresis <sup>Cust</sup> / 10 time constant / 11 Invert Signal <sup>Cust</sup> / 12 Special Function <sup>Opt, Cust</sup> / 13 information  <b>status output<sup>Opt.</sup>:</b> 1 mode / 2 output A <sup>Opt</sup> / 2 output C <sup>Opt</sup> / 2 output D <sup>Opt</sup> / 3 invert signal / 4 information  <b>limit switch<sup>Opt.</sup>:</b> 1 measurement / 2 threshold / 3 hysteresis / 4 polarity / 5 time constant / 6 invert signal / 7 information  <b>control input<sup>Opt.</sup>:</b> 1 mode <sup>Cust</sup> / 2 invert signal / 3 information
	3 C	
	4 D	
3 I/O counter	1 counter 1	
	2 Totaliser 2	
4 I/O HART	1 PV is <sup>Rd</sup> / 2 SV is / 3 TV is / 4 4V is / 5 D/A trim <sup>Cust</sup> / 6 apply values <sup>Cust</sup> / 7 HART units	

5 device	1 device info	1 tag / 2 C number <sup>Rd</sup> / 3 device serial no. <sup>Rd</sup> / 4 electronic serial no. <sup>Rd</sup> / 5 SW.REV.MS / 6 circuit board info		
	2 display	1 language / 2 default display <sup>Cust</sup> / 3 SW.REV.UIS		
	3 1. meas. page 4 2. meas. page	1 function <sup>Cust</sup> / 2 measurement 1.line <sup>Cust</sup> / 3 range min <sup>Cust</sup> / 4 range max <sup>Cust</sup> / 5 limitation min / 6 limitation max / 7 lfc threshold / 8 lfc hysteresis / 9 time constant / 10 format 1.line / 11 measurement 2.line <sup>Cust</sup> / 12 format 2.line <sup>Cust</sup> / 13 measurement 3.line <sup>Cust</sup> / 14 format 3.line <sup>Cust</sup>		
	5 graphic page	1 select range / 2 range centre / 3 range +/- / 4 time scale		
	6 special functions	1 list errors / 2 reset errors / 3 warmstart		
	7 units (device)	1 volume flow <sup>Cust</sup> / 2 mass flow <sup>Cust</sup> / 3 flow speed <sup>Cust</sup> / 4 conductivity <sup>Cust</sup> / 5 temperature <sup>Cust</sup> / 6 volume <sup>Cust</sup> / 7 mass <sup>Cust</sup> / 8 density <sup>Cust</sup>		
	8 HART	1 address		
		2 message		
		3 description		
		4 units (HART)	1 volume flow	
		5 formats (HART)	2 mass flow	
			3 flow speed	
			4 conductivity	
			5 temperature	
			6 counter 1	
7 counter 2				
8 diagnosis value				
6 device info		1 manufacturer <sup>Rd</sup>		
		2 model <sup>Rd</sup>		
		3 device ID <sup>Rd</sup>		
	4 tag			
	5 date			
	6 write protect <sup>Rd</sup>			
	7 final assembly no.			
	8 sensor serial no.			
7 preambles	9 <b>revision no.</b> 1 universal rev. <sup>Rd</sup> 2 device rev. <sup>Rd</sup> 3 software rev. <sup>Rd</sup> 4 hardware rev. <sup>Rd</sup>			
	1 request preams <sup>Rd</sup>			
2 response preams				
8 master reset				
9 prepare download				

## 9.12 Appendix B: HART<sup>®</sup> menu tree for AMS

### Abbreviations of the following tables:

- <sup>Opt</sup> Optional, depending on device version and configuration
- <sup>Rd</sup> Read only
- <sup>Cust</sup> Custody lock protection
- <sup>Loc</sup> Local AMS, affects only AMS views

### 9.12.1 Overview AMS menu tree (positions in menu tree)

Configure	quick setup	
	sensor	
	input calibration	
	input filter	
	self test / info	
	I/O terminals A/C/D	current output
		frequency output
		pulse output
		status output
		limit switch
	counter	counter 1
		counter 2
	device	
	1. meas. page / graphic page / 2. meas. page	
HART		
HART units		
Compare		
Clear Offline		
Status	Overview	
	Failure (device)	
	Failure (application)	
	Out of specification	
	Check request & Information	
Process Variables	process values	
	counter	
	outputs	
	device	
	HART	
Scan Device		
Calibration Management		
Diagnostics and Test		
Calibrate		
Reset		
Basic Configuration		

Rename
Unassign
Assign / Replace
Audit Trail
Record Manual Event
Drawings / Notes
Help...

9.12.2 AMS menu tree (details for settings)

Configure

quick setup	device	language / tag	
	current output A	measurement A <sup>Cust</sup> / unit A <sup>Cust</sup> / time constant A <sup>Cust</sup> / range max A <sup>Cust</sup> / range min A <sup>Cust</sup> / lfc threshold <sup>Cust</sup> / lfc hysteresis <sup>Cust</sup>	
	pulse output D	measurement D <sup>Opt, Cust</sup> / pulse value unit <sup>Opt, Cust</sup> / value p. pulse <sup>Opt, Cust</sup> / lfc threshold <sup>Opt, Cust</sup> / lfc hysteresis <sup>Opt, Cust</sup>	
sensor	limits for...	volume flow	upper snsr limit <sup>Rd</sup> / lower snsr limit <sup>Rd</sup> / minimum span <sup>Rd</sup>
		mass flow	
		flow speed	
		conductivity	
		coil temperature	
input calibration	zero calibration <sup>Cust</sup> / size <sup>Cust</sup> / GKL <sup>Opt, Cust</sup> / coil resistance Rsp <sup>Cust</sup> / density <sup>Cust</sup> / target conductivity <sup>Cust</sup> / EF electr. factor <sup>Cust</sup> / field frequency <sup>Cust</sup> / select settling <sup>Cust</sup> / settling time <sup>Opt, Cust</sup> / line frequency <sup>Cust</sup>		
input filter	limitation min <sup>Cust</sup> / limitation max <sup>Cust</sup> / flow direction <sup>Cust</sup> / time constant / pulse filter <sup>Cust</sup> / pulse width <sup>Cust</sup> / pulse limitation <sup>Cust</sup> / noise filter <sup>Cust</sup> / noise level <sup>Cust</sup> / noise suppression <sup>Opt, Cust</sup> / lfc threshold <sup>Cust</sup> / lfc hysteresis <sup>Cust</sup>		
self test / info	self test	empty pipe <sup>Cust</sup> / limit empty pipe <sup>Opt, Cust</sup> / electrode noise <sup>Cust</sup> / limit electr. noise <sup>Opt, Cust</sup> / settling of field <sup>Cust</sup> / diagnosis value <sup>Rd</sup>	
	information	liner / electr. material / serial no. sensor <sup>Rd</sup> / V no. sensor <sup>Rd</sup> /	

I/O terminals A/C/D	current output <sup>Opt</sup>	range 0% <sup>Cust</sup> / range 100% <sup>Cust</sup> / extended range min <sup>Cust</sup> / extended range max <sup>Cust</sup> / error current <sup>Cust</sup> / error condition <sup>Cust</sup> / measurement <sup>Cust</sup> / range min <sup>Cust</sup> / range max <sup>Cust</sup> / polarity <sup>Cust</sup> / limitation min <sup>Cust</sup> / limitation max <sup>Cust</sup> / lfc threshold <sup>Cust</sup> / lfc hysteresis <sup>Cust</sup> / time constant <sup>Cust</sup> / special function <sup>Cust</sup> / rc threshold <sup>Opt, Cust</sup> / rc hysteresis <sup>Opt, Cust</sup>
	frequency output <sup>Opt</sup>	pulse shape <sup>Cust</sup> / pulse width <sup>Cust</sup> / 100% pulse rate <sup>Cust</sup> / measurement <sup>Cust</sup> / range min <sup>Cust</sup> / range max <sup>Cust</sup> / polarity <sup>Cust</sup> / limitation min <sup>Cust</sup> / limitation max <sup>Cust</sup> / lfc threshold <sup>Cust</sup> / lfc hysteresis <sup>Cust</sup> / time constant / invert signal <sup>Cust</sup> / special function <sup>Opt, Cust</sup>
	pulse output <sup>Opt</sup>	pulse shape <sup>Cust</sup> / pulse width <sup>Cust</sup> / max. pulse rate <sup>Cust</sup> / measurement <sup>Cust</sup> / pulse value unit / value p. pulse / polarity <sup>Cust</sup> / lfc threshold <sup>Cust</sup> / lfc hysteresis <sup>Cust</sup> / time constant / invert signal <sup>Cust</sup> / special function <sup>Opt, Cust</sup>
	status output <sup>Opt</sup>	mode <sup>Cust</sup> / output A <sup>Opt</sup> / output C <sup>Opt</sup> / output D <sup>Opt</sup> / invert signal
	limit switch <sup>Opt</sup>	measurement <sup>Cust</sup> / threshold / hysteresis / polarity / time constant / invert signal
	control input <sup>Opt</sup>	mode <sup>Cust</sup> / invert signal
counter	counter 1	function <sup>Cust</sup> / measurement <sup>Opt, Cust</sup> /
	counter 2	lfc threshold <sup>Opt, Cust</sup> / lfc hysteresis <sup>Opt, Cust</sup> / time constant <sup>Opt, Cust</sup> / preset value <sup>Opt, Cust</sup>
device	device info	tag / C number <sup>Rd</sup> / device serial no. <sup>Rd</sup> / electronic serial no. <sup>Rd</sup>
	display	language / default display <sup>Cust</sup>
	units	volume flow <sup>Cust</sup> / mass flow <sup>Cust</sup> / flow speed <sup>Cust</sup> / conductivity <sup>Cust</sup> / temperature <sup>Cust</sup> / volume <sup>Cust</sup> / mass <sup>Cust</sup> / density <sup>Cust</sup>
1. and 2. meas. page graphic page	1. and 2. meas. page	function <sup>Cust</sup> / measurement 1.line <sup>Cust</sup> / range min <sup>Cust</sup> / range max <sup>Cust</sup> / limitation min / limitation max / lfc threshold / lfc hysteresis / time constant / format 1.line / measurement 2.line <sup>Cust</sup> / format 2.line <sup>Cust</sup> / measurement 3.line <sup>Cust</sup> / format 3.line <sup>Cust</sup>
	graphic page	select range / range centre / range +/- / time scale

HART	identification	manufacturer <sup>Rd</sup> / model <sup>Rd</sup> / device ID <sup>Rd</sup> / address / tag / date / message / description / write protect <sup>Rd</sup> / final assembly no. / sensor serial no.
	revision numbers	universal rev. <sup>Rd</sup> / device rev. <sup>Rd</sup> / software rev. <sup>Rd</sup> / hardware rev. <sup>Rd</sup>
	preambles	request preams <sup>Rd</sup> / response preams
	dynamic variables	PV is <sup>Rd</sup> / SV is / TV is / 4V is
HART units	display formats	volume flow <sup>Loc</sup> / mass flow <sup>Loc</sup> / flow speed <sup>Loc</sup> / conductivity <sup>Loc</sup> / temperature <sup>Loc</sup> / counter 1 <sup>Loc</sup> / counter 2 <sup>Loc</sup> / diagnosis value <sup>Opt, Loc</sup>
	units	volume flow / mass flow / flow speed / conductivity / temperature / counter 1 / counter 2 /

Compare and Clear Offline

Status

Overview	Standard	Primary variable out of limits
		Non-primary variable out of limits
		Primary variable analogue output saturated
		Primary variable analogue output fixed
		Cold start
		Field device malfunction
		Configuration changed
Failure (device)	F error in device / F IO1 / F parameter / F configuration / F display / F sensor electronic / F sensor global / F sensor local / F field current local / F current output A / F software user interface / F hardware settings / F hardware detection / F RAM/ROM error IO1	
Failure (application)	F application error / F empty pipe / F flow rate too high / F field frequency too high / F DC offset / F open circuit A / F over range A (current) / F over range D (pulse) / F active settings / F factory settings / F backup 1 settings / F backup 2 settings	
Out of specification	S out of specification / S pipe not full / S pipe empty / S linearity / S flow profile / S electrode noise / S gain error / S electrode symmetry / S field coil broken / S field coil bridged / S field current deviation / S field frequency too high / S electronic temperature / S coil temperature / S overflow counter 1 / S overflow counter 2 / S Backplane Invalid	
Check request & Information	check request	C checks in progress / C test sensor
	information	I counter 1 stopped / I counter 2 stopped / I power fail / I over range display 1 / I over range display 2 / I backplane sensor / I backplane settings / I backplane difference / I optical interface



**Process Variables**

process values	volume flow / mass flow / flow speed / conductivity / coil temperature / diagnosis value Opt
counter	counter 1 <sup>Opt</sup> / counter 2 <sup>Opt</sup>
outputs	A <sup>Opt</sup> / % range A <sup>Opt</sup> / D <sup>Opt</sup> / % range D <sup>Opt</sup>
device	tag <sup>Rd</sup> / description <sup>Rd</sup>
HART	polling address <sup>Rd</sup> / device ID <sup>Rd</sup>

**Scan Device****Calibration Management****Diagnostics and Test**

	simulation A <sup>Opt, Cust</sup> / simulation D <sup>Opt, Cust</sup> / circuit board info
--	--

**Calibrate**

	autom. zero calibration <sup>Cust</sup> / D/A trim <sup>Cust</sup> / apply values <sup>Cust</sup>
--	---

**Reset**

	reset errors / reset configuration changed flag / master reset / warmstart / reset counter 1 <sup>Cust</sup> / set counter 1 <sup>Cust</sup> / reset counter 2 <sup>Cust</sup> / set counter 2 <sup>Cust</sup>
--	---

**Basic Configuration**

	select measurement counter 1 / select measurement counter 2 / select diagnosis value
--	--

**Rename****Unassign****Assign / Replace****Audit Trail****Record Manual Event****Drawings / Notes****Help...**

### 9.13 Appendix C: HART<sup>®</sup> menu tree for PDM

Abbreviations of the following tables:

- <sup>Opt</sup> Optional, depending on device version and configuration
- <sup>Rd</sup> Read only
- <sup>Cust</sup> Custody lock protection
- <sup>Loc</sup> Local PDM, affects only PDM views

#### 9.13.1 Overview PDM menu tree (positions in menu tree)

##### Overview: Menu Device

Communication Path
Load To Device
Load To PG/PC
Set Address
Test
Reset
Calibration
HART

##### Overview: Menu View

Display Values	Display Values
	Counter
Yt diagram	
Outputs	current output A <sup>Opt</sup>
	frequency output D <sup>Opt</sup>
Device Status	Device
	HART
	Standard (overview)
	Failure (device)
	Failure (application)
	Out of specification
	Check request
Information	
PCB Information	
Toolbar	
Status Bar	
Update	

## Overview: PDM parameter table

Identification	Operation Unit		
	Devices		
Input	Calibration		
	Filter		
	Self Test		
	Information		
	Measuring Limits	volume flow	
		mass flow	
flow speed			
conductivity			
coil temperature			
I/O	A <sup>Opt</sup>		
	C <sup>Opt</sup>		
	D <sup>Opt</sup>		
	counter 1		
	counter 2		
Display and user interface	local display	1. and 2. meas. page	
		graphic page	
	units (device)		
	units (HART)		
	formats (HART)		

## 9.13.2 PDM menu tree (details for settings)

## Menu Device

Communication Path		
Load To Device		
Load To PG/PC		
Set Address		
test	simulation current output A <sup>Opt, Cust</sup>	
	simulation frequency output D <sup>Opt, Cust</sup>	
reset	<reset errors>	
	<reset configuration changed flag>	
	<master reset>	
	<warmstart>	
	<reset counter 1> <sup>Cust</sup>	
	<set counter 1> <sup>Cust</sup>	
	<reset counter 2> <sup>Cust</sup>	
<set counter 2> <sup>Cust</sup>		
calibration	autom. zero calibration <sup>Cust</sup>	
	D/A trim <sup>Cust</sup>	
	apply values <sup>Cust</sup>	
HART	preambles	request preams <sup>Rd</sup> / response preams
	dynamic variables settings	PV is <sup>Rd</sup> / SV is / TV is / 4V is

## Menu View

display values	volume flow / mass flow / flow speed / conductivity / coil temperature / diagnosis value / device status	
counter	counter 1 <sup>Opt</sup> / counter 2 <sup>Opt</sup>	
Yt diagram	volume flow / mass flow	
Outputs	current output A <sup>Opt</sup>	measured value <sup>Opt</sup> / A <sup>Opt</sup> / % range A <sup>Opt</sup>
	frequency output D <sup>Opt</sup>	measured value <sup>Opt</sup> / D <sup>Opt</sup> / % range D <sup>Opt</sup>
Device Status	device	C number <sup>Rd</sup> / device serial no. <sup>Rd</sup> / electronic serial no. <sup>Rd</sup>
	HART	tag / manufacturer <sup>Rd</sup> / write protect <sup>Rd</sup> / model <sup>Rd</sup> / device ID / universal rev. <sup>Rd</sup> / device rev. <sup>Rd</sup> / software rev. <sup>Rd</sup> / hardware rev. <sup>Rd</sup> / date <sup>Rd</sup> / final assembly no. <sup>Rd</sup> / sensor serial no. <sup>Rd</sup>
	Standard (overview)	Primary variable out of limits
		Non-primary variable out of limits
		Primary variable analog output saturated
		Primary variable analog output fixed
		Field Device Cold Start
		Configuration changed
	Failure (device)	Malfunction
F error in device / F IO1 / F parameter / F configuration / F display / F sensor electronic / F sensor global / F sensor local / F field current local / F current output A / F software user interface / F hardware settings / F hardware detection / F RAM/ROM error IO1		
Failure (application)	F application error / F empty pipe / F flow rate too high / F field frequency too high / F DC offset / F open circuit A / F over range A (current) / F over range D (pulse) / F active settings / F factory settings / F backup 1 settings / F backup 2 settings	
Out of specification	S out of specification / S pipe not full / S pipe empty / S linearity / S flow profile / S electrode noise / S gain error / S electrode symmetry / S field coil broken / S field coil bridged / S field current deviation / S field frequency too high / S electronic temperature / S coil temperature / S overflow counter 1 / S overflow counter 2 / S backplane invalid	
Check request	C checks in progress / C test sensor	

Device Status	Information	I counter 1 stopped / I counter 2 stopped / I power fail / I over range display 1 / I over range display 2 / I backplane sensor / I backplane settings / I backplane difference / I optical interface
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**PCB Information**

**Toolbar**

**Status Bar**

**Update**

**PDM parameter table**

**Identification**

operation unit	tag / description / message
Device	C number <sup>Rd</sup> / device serial no. <sup>Rd</sup> / electronic serial no. <sup>Rd</sup> / manufacturer <sup>Rd</sup> / model <sup>Rd</sup> / device ID <sup>Rd</sup> / universal rev. <sup>Rd</sup> / device rev. <sup>Rd</sup> / software rev. <sup>Rd</sup> / hardware rev. <sup>Rd</sup> / date / final assembly no. / sensor serial no.

**input**

calibration	zero calibration <sup>Cust</sup> / size <sup>Cust</sup> / GKL <sup>Opt, Cust</sup> / density <sup>Cust</sup> / target conductivity <sup>Cust</sup> / EF electr. factor <sup>Cust</sup> / field frequency <sup>Cust</sup> / select settling <sup>Cust</sup> / settling time <sup>Opt, Cust</sup> / line frequency <sup>Cust</sup>						
filter	limitation min <sup>Cust</sup> / limitation max <sup>Cust</sup> / flow direction <sup>Cust</sup> / time constant / pulse filter <sup>Cust</sup> / pulse width <sup>Opt, Cust</sup> / pulse limitation <sup>Opt, Cust</sup> / noise filter <sup>Cust</sup> / noise level <sup>Opt, Cust</sup> / noise suppression <sup>Opt, Cust</sup> / lfc threshold <sup>Cust</sup> / lfc hysteresis <sup>Cust</sup>						
self test	empty pipe <sup>Cust</sup> / limit empty pipe <sup>Opt, Cust</sup> / electrode noise <sup>Cust</sup> / limit electr.noise <sup>Opt, Cust</sup> / settling of field <sup>Cust</sup> / diagnosis value						
information	liner / electr. material / serial no. sensor <sup>Rd</sup> / V no. sensor <sup>Rd</sup>						
Measuring limits for ...	<table border="1"> <tr> <td>... volume flow</td> <td rowspan="5">upper sensr limit<sup>Rd</sup> / lower sensr limit<sup>Rd</sup> / minimum span<sup>Rd</sup></td> </tr> <tr> <td>... mass flow</td> </tr> <tr> <td>... flow speed</td> </tr> <tr> <td>... conductivity</td> </tr> <tr> <td>... coil temperature</td> </tr> </table>	... volume flow	upper sensr limit <sup>Rd</sup> / lower sensr limit <sup>Rd</sup> / minimum span <sup>Rd</sup>	... mass flow	... flow speed	... conductivity	... coil temperature
... volume flow	upper sensr limit <sup>Rd</sup> / lower sensr limit <sup>Rd</sup> / minimum span <sup>Rd</sup>						
... mass flow							
... flow speed							
... conductivity							
... coil temperature							

## I/O

I/O	terminals A <sup>Cust</sup> / terminals C <sup>Cust</sup> / terminals D <sup>Cust</sup>	
A / C / D <sup>Opt</sup>	current output <sup>Opt</sup>	range 0% <sup>Cust</sup> / range 100% <sup>Cust</sup> / extended range min <sup>Cust</sup> / extended range max <sup>Cust</sup> / error current <sup>Cust</sup> / error condition <sup>Cust</sup> / measurement <sup>Cust</sup> / range min <sup>Cust</sup> / range max <sup>Cust</sup> / polarity <sup>Cust</sup> / limitation min <sup>Cust</sup> / limitation max <sup>Cust</sup> / lfc threshold <sup>Cust</sup> / lfc hysteresis <sup>Cust</sup> / time constant / special function <sup>Cust</sup> / rc threshold <sup>Opt, Cust</sup> / rc hysteresis <sup>Opt, Cust</sup>
	frequency output <sup>Opt</sup>	pulse shape <sup>Cust</sup> / pulse width <sup>Cust</sup> / 100% pulse rate <sup>Cust</sup> / measurement <sup>Cust</sup> / range min <sup>Cust</sup> / range max <sup>Cust</sup> / polarity <sup>Cust</sup> / limitation min <sup>Cust</sup> / limitation max <sup>Cust</sup> / lfc threshold <sup>Cust</sup> / lfc hysteresis <sup>Cust</sup> / time constant / invert signal <sup>Cust</sup> / special function <sup>Opt, Cust</sup>
	pulse output <sup>Opt</sup>	pulse shape <sup>Cust</sup> / pulse width <sup>Cust</sup> / max pulse rate <sup>Cust</sup> / measurement <sup>Cust</sup> / pulse value unit / value p. pulse / polarity <sup>Cust</sup> / lfc threshold <sup>Cust</sup> / lfc hysteresis <sup>Cust</sup> / time constant / invert signal <sup>Cust</sup> / special function <sup>Opt, Cust</sup>
	status output <sup>Opt</sup>	mode / output A <sup>Opt</sup> / output C <sup>Opt</sup> / output D <sup>Opt</sup> / invert signal
	limit switch <sup>Opt</sup>	measurement / threshold / hysteresis / polarity / time constant / invert signal
	control input <sup>Opt</sup>	mode <sup>Cust</sup> / invert signal
	counter	counter 1
	counter 2	

## Display and user interface

local display	language / default display <sup>Opt</sup>	
1. and 2. meas. page	function <sup>Cust</sup> / measurement 1.line <sup>Cust</sup> / range min <sup>Cust</sup> / range max <sup>Cust</sup> / limitation min / limitation max / lfc threshold / lfc hysteresis / time constant / format 1.line / measurement 2.line <sup>Cust</sup> / format 2.line <sup>Cust</sup> / measurement 3.line <sup>Cust</sup> / format 3.line <sup>Cust</sup>	
graphic page	select range / range centre / range +/- / time scale	
Units (device)	unit for ...	volume flow <sup>Cust</sup> / mass flow <sup>Cust</sup> / flow speed / conductivity / temperature / volume <sup>Cust</sup> / mass <sup>Cust</sup> / density <sup>Cust</sup>
Units (HART)	unit for ...	volume flow / mass flow / flow speed / conductivity / coil temperature / counter 1 / counter 2
Formats (HART)	format for ...	volume flow <sup>Loc</sup> / mass flow <sup>Loc</sup> / flow speed <sup>Loc</sup> / conductivity <sup>Loc</sup> / coil temperature <sup>Loc</sup> / counter 1 <sup>Loc</sup> / counter 2 <sup>Loc</sup> / diagnosis value <sup>Opt, Loc</sup>



### KROHNE product overview

- Electromagnetic flowmeters
- Variable area flowmeters
- Ultrasonic flowmeters
- Mass flowmeters
- Vortex flowmeters
- Flow controllers
- Level meters
- Temperature assemblies
- Pressure transmitters
- Analysis products
- Products and systems for the oil & gas industry
- Measuring systems for the marine industry

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**KROHNE**